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ECONOMIC GEOGRAPHY

JANUARY

THE AFFORESTATION OF BRITAIN
T. W. Birch

AGRICULTURAL REGIONS OF ASIA
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RISE OF THE PORT OF VANCOUVER, BRITISH COLUMBIA
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TOPOGRAPHY AND TOWNS OF THE CAROLINA PIEDMONT
S. T. Emory

METHODS EMPLOYED BY GEOGRAPHERS IN REGIONAL SURVEYS
G. Donald Hudson

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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ECONOMIC GEOGRAPHY

CONTENTS FOR JANUARY, 1936

PAGE

THE AFFORESTATION OF BRITAIN 1
T. W. BIRCH

AGRICULTURAL REGIONS OF ASIA: PART IX—JAVA 27
SAMUEL VAN VALKENBURG

A NEW MAP OF THE MANUFACTURING BELT OF NORTH AMERICA 45
RICHARD HARTSHORNE

NEW COLONIES IN OLD QUEBEC 54
HAROLD S. KEMP

RISE OF THE PORT OF VANCOUVER, BRITISH COLUMBIA 61
LEAH STEVENS

VITICULTURE IN OHIO 71
PAUL CROSS MORRISON

PACIFIC COAST OIL AND NATURAL GAS 86
WILLIS H. MILLER

TOPOGRAPHY AND TOWNS OF THE CAROLINA PIEDMONT 91
S. T. EMORY

METHODS EMPLOYED BY GEOGRAPHERS IN REGIONAL SURVEYS 98
G. DONALD HUDSON

REVIEWS 105

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FORESTRY

THE significance of forests in the economy of the world has but relatively recently been forced upon the attention of its peoples. Until a few centuries ago an abundance of timber was available to most of the world's peoples, for they dwelt in largest numbers where copious rainfall insured fullness of life and luxuriance of tree growth. The grasslands of the world with their opportunities only for pastoral nomadism were but sparsely occupied.

Much of the economy of industrial nations is based upon use of wood. The states of western Europe and eastern America where modern industry arose and flourished were blessed with primary stores of timber that the ages had grown, and only recently were those stores depleted. The part that timber played in the development of architecture, of navigation, of manufacturing cannot be exaggerated.

Now those stores of timber have been so depleted as to face exhaustion. It behooves the forward-looking governments of the world to take careful thought for the forestry supplies of the future, that adequacy may be insured. Dearth of timber, and pulp and other woodland products, is neither desirable nor necessary.

Reforestation of denuded terrain where only forests can yield satisfactory economic returns; afforestation of waste lands where trees will grow and provide cover for game, protection for water supplies, timber for fuel and construction; both phases of forestry must go hand in hand with conservation, that the timber supply of the years to come be assured, and the face of the waste lands be made beautiful.

ECONOMIC GEOGRAPHY

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THE AFFORESTATION OF BRITAIN

T. W. Birch

DURING the present century nearly every country has attached more and more importance to national stock-taking. Among resources which have received critical attention have been those relating to timber, and this for a number of reasons. In the first place, forest resources, unlike mineral wealth, are replaceable, but in order to prevent exhaustion, long period planning is essential. The leading industrial countries recognize that the timber resources of the world, especially of softwoods, cannot continue indefinitely to meet the present demand, irrespective of the rising per capita consumption. Timber must, therefore, be produced as a crop, not removed as a mineral. At the same time there is a marked tendency on the part of all countries deliberately to foster economic self-sufficiency against a period of crisis, whatever the origin of that crisis may be. Improved transport has made possible a more rational land utilization than hitherto, when regions had to be self-supporting. Each region can now aim at a capacity yield of the commodity to which it is best suited, and which fits best into the economic requirements of its political unit.

Great Britain has proved no exception to these general tendencies, unless it has been by a slower response to the trend of world events. But today afforestation is in progress in Britain, and the landscape is undergoing a visible change, not back to the broad-leaved forests which it is assumed at one time covered nearly the whole of Britain, but forward to a dark serrated skyline of conifers.

The forests of Britain have had a long history. They have played an all-important part in the development of her national and international life, and they may once again come into some measure of importance in her industrial life. The present position is the result of Britain's forest policy, the history of which can be divided into four distinct periods. (See First Annual Report of the Forestry Commissioners, 1921, pp. 5–14.) The first was a period of destruction which lasted from the relaxation of the severe forest laws in the thirteenth and fourteenth centuries, to the middle or end of the eighteenth century. Previously, the Normans had preserved and even extended the forests for hunting, and they had been used also to graze cattle and to provide pannage for swine, a right still enjoyed by commoners in the New Forest. As forest laws were relaxed, license took their place, and before 1500 there was alarm about the national timber supply! Succeeding centuries witnessed clearance for agriculture, fellings for smelting tin, copper, and iron ores, burning of undergrowth for grazing, and wholesale destruction to provide sheep walks. Today, many regions which bear the name forest, such as Rothbury Forest in Northumberland, have no vestige of trees.

The second period was one of private

enterprise. Towards the middle of the eighteenth century in some districts, and later in others, the demand for timber, notably for ships, gave rise to private planting. There was some encouragement here and there by a system of grants, and in 1786 the government proposed that 100,000 acres of land should be planted with oak to produce timber for the navy. There was little interest, however, when the era of wooden ships came to an end. Some quick-growing conifers, hitherto unplanted in Britain, were introduced and these formed an important source of timber during the Great War.

The third period, from 1885–1915, was one of enquiry, caused by the rapidly increasing imports of timber. The annual average imports of hewn and sawn timber and staves in the decade 1843–1852 were less than 2 million loads: in the decade 1903–1912 they were more than 9½ million loads. A Select Committee of the House of Commons was set up in 1885 to examine the position, and a Royal Commission of 1909 outlined very comprehensive schemes for afforestation of nine million acres of land. Little of a practical nature resulted, though between 1850 and 1910 annual per capita consumption had increased from 3½ cubic feet to nearly 11 cubic feet, prices had risen, and home production had fallen to about 10% of the total consumption. The cause of inaction was simply that Britain could draw all the softwood she needed from the abundant supply round the Baltic, and at a lower price than she could produce it. Russia alone supplied practically one-half of Britain's requirements of coniferous timber and pitwood in 1913, and Sweden came next. In that year, grain and timber absorbed nearly 25% of the total tonnage of ships entering our ports from abroad, and this figure could not be reduced by 1% when war broke out, until French and home timber resources were freely drawn upon. Thus these three periods led directly to the fourth, that of State Action.

FIGURE 1.—Types of woodland in Great Britain. The contribution made by each type of Great Britain's woodland area of approximately three million acres is shown.

It is with this period that we are particularly concerned, but in order to appreciate more fully the need, aims and objects of State action, and its contribution to the afforestation of Britain, we shall first examine in some detail Britain's present woodland area, her production, the plans for afforestation which have been approved, and then the progress which has been made. Finally we shall review Britain's timber imports, completing a background against which her present forest policy is thrown into high relief.

GREAT BRITAIN'S WOODLAND AREA

According to the Census of Woodlands, 1924 (*Report on Census of Woodlands and Census of Production of Home Grown Timber, 1924*. Published H. M. Stationery Office 1929. The second census, due 1934, has been deferred till 1944), 2,958,672 acres or 5.3% of Great Britain's area was for-

ested. The types of woodland and the proportion under each are shown in Figure 1. The primary division is into economic or potentially economic, and uneconomic woodland. The former include all woods maintained or capable of being maintained for the production of timber for commercial purposes, hence there fall under this head large areas of scrub, felled, and devastated woods. Uneconomic woods are those not maintained for timber production and include amenity woods, shelter belts, and park timber. The designation is not altogether suitable as these woods have a very definite economic as well as an important aesthetic value in rural Britain. Of the economic or potentially economic woodland area, only approximately one-half can be classified as carrying high forest. This is divided among conifers, hardwoods, and mixed conifers and hardwoods, roughly in the ratio four-three-two. Areas which cannot be classified as carrying high forest are subdivided under one of three headings, namely: (1) land bearing coppice and coppice with standards, (2) scrubland, or (3) felled or devastated areas (Figure 2). It will be seen that a large proportion falls under the last heading, actually 16.1% of the total woodland area of Great Britain. Add to this the area covered by scrub, and it follows that over one-quarter of Great Britain's woodland area is producing nothing and less than one-half is reasonably productive.

The cause of such a large area of felled or devastated woodland—an area little short of half a million acres, was the Great War, for during and immediately after the war 444,000 acres were cut, excluding coppice. This huge inroad was made upon the limited resources largely to free shipping for such commodities as foodstuffs of which the country had no available reserves, and also because of the difficulties of importing timber under the conditions then prevailing. Areas tell only half the story, for it is estimated that during the same period, despite stringent economy, the volume cut was 1,000 million cubic feet, equivalent roughly to one-third the total volume standing in 1914. (Census of Woodlands, 1924, p. 16.) Conifers, ash, and oak were the chief woods involved.

FIGURE 2.—Typical coppice in the Forest of Dean, Monmouthshire. More than one-sixth of Britain's woodland is classified as "coppice" and "coppice with standards."

The counties which suffered most devastation were Cardigan, Pembroke, and Carmarthen in Wales, and Clackmannan in Scotland, each of which had over 35% of its woodland area felled. Further fellings occurred immediately after the War and in subsequent years due to the break-up of big estates, the purchasers realizing quick money on as much of the mature timber as possible. Much of this timber would otherwise have remained uncut.

DISTRIBUTION OF WOODLAND

(*a*) *By Countries and Counties.* Bearing in mind the difference in topography and population of England, Wales, and Scotland, it is rather remarkable that practically the same percentage area of each country is forested, figures being respectively 5.1%, 5.0%, and 5.6%, though of course this implies that the actual area in each which is oc-

cupied by forest is different, as shown in Figure 3. Broadly speaking, the area somewhat exceeds 1½ million acres in England, ¼ million acres in Wales, and 1 million acres in Scotland. The percentage area and distribution of woodland by counties is shown in Figure 4. (Statistical Tables, Census of Production, 1924, pp. 22–46.) In England, the most sparsely wooded counties form a continuous belt from Solway to Thames, isolating Nottinghamshire, which has 5.6% of its area wooded. The greater percentage of woodland in this county is due mainly to remnants of the once extensive Sherwood Forest, of Robin Hood fame. The only other part of England in the under 4% category is Cornwall. Middlesex and Cambridgeshire have the lowest percentage area in woodland of all English counties, having 0.9% and 1.0% respectively. The most heavily wooded part is the southeast, Sussex having 14% of its area in woodland, chiefly in the form of coppice and coppice-with-standards. In the whole of Britain, there are over half a million acres of this somewhat poor form of sylviculture: 91.8% of the total is to be found in England and 45% in these southeastern counties. Poles are grown particularly for use in the hop gardens.

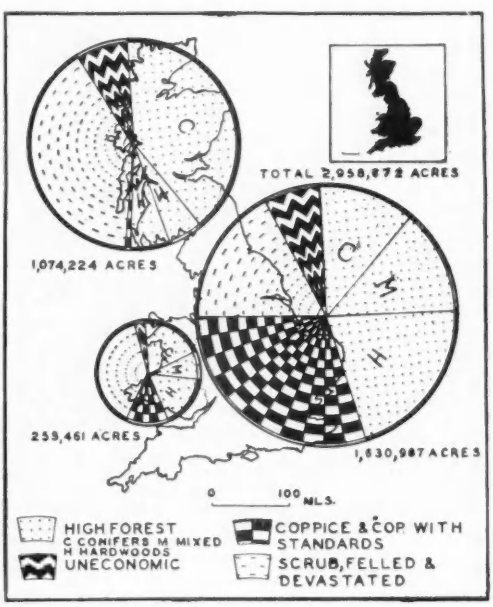

FIGURE 3.—Proportional distribution of Britain's woodland area by countries and types. Inset map shows the total area in woodland drawn to the same scale as the larger map.

In Wales, least woodland is found in the northwest and in the southwest. The only county with more than 10% of its area in woodland is Monmouthshire (12.8%). (For some purposes Monmouthshire is considered as in Wales, and for others, as in England.) The greater percentage here is due to the Forest of Dean, a Crown Forest until placed under the control of the Forestry Commissioners.

In Scotland, the principal region with less than 4% forested is in the northwest highlands. Caithness has the record for lowest percentage area in Great Britain, with 0.4%. On the other side of the Moray Firth, Nairn and Elgin come first in Great Britain with 17.0% and 16.3% respectively. This distribution is not to be explained in terms of geography alone.

(*b*) *By Types.* There is a notable difference in the relative proportions of different types of woodland within the three countries (Figure 3). In England, almost one-half falls under the category of high forest, and considerably more than one-quarter is coppice and coppice with standards. In Wales, there is about the same proportion of high forest, but there is far less coppice, and far more scrub, felled, or devastated. Scotland alone has more than one-half its woodland classified as high forest and has only a negligible area of coppice land.

(*c*) *By Species.* The same species of trees are to be found in the forests of all three countries, but in Scotland there is a preponderance of softwoods

TABLE I

PERCENTAGE DISTRIBUTION AND AREA OF HIGH FOREST IN GREAT BRITAIN, 1924

	England		*Wales*		*Scotland*	
	Percentage	*Area (Acres)*	*Percentage*	*Area (Acres)*	*Percentage*	*Area (Acres)*
Conifers	25.9	195,231	41.5	46,940	78.1	429,670
Hardwoods	44.9	338,456	38.9	43,957	11.1	60,941
Mixed	29.2	220,390	19.6	22,106	10.8	59,199

Census of Woodlands 1924, Table III, and pp. 7 and 8.

(78.1%), while in England there is a preponderance of hardwoods (44.9%). The percentage distribution and area of high forest by types is shown in Table I.

(*d*) *By Age.* A census of the timber resources of any country is incomplete unless some account is taken of the age of the timber. Consequently, the 1924 Census of Woodlands gave the respective age groups of high forest in Great Britain, and these have been shown diagrammatically in Figure 5. It is assumed that the normal period of rotation for conifers is 80 years, for hardwoods 120 years, and for mixed conifers and hardwoods 100 years. On this basis it can be estimated whether the distribution by age groups is normal, or whether any particular age group is excessive or deficient in acreage. It will be seen from the diagram that the distribution of conifers is fairly normal. There is a larger area under 40 years than 40–80 years, consistent with the desire to increase acreage. There is a comparatively small area exceeding 80 years —that is, conifers standing longer than the normal period for full development. The distribution of hardwoods, however, is wholly abnormal. Only a very small area was under 20 years, while the great bulk was over 40 years. This means that for many years there will be a supply of mature hardwoods, but when the existing hardwoods have been cut, there will be no plantations coming of age. In the decade 1914–1923 less than 5,000 acres of hardwoods were planted. Distribution of mixed high forest by age is also abnormal. So far as distribution by age groups within the three separate countries is concerned, the most outstanding points are that 10.5% of Scotland's High Forest is of conifers which exceed 80 years in age, and that 20.9% of England's high forest is of hardwoods exceeding 80 years in age.

PRODUCTION OF TIMBER IN GREAT BRITAIN, 1924 AND 1930

The Report on Census of Woodlands and Census of Production of Home

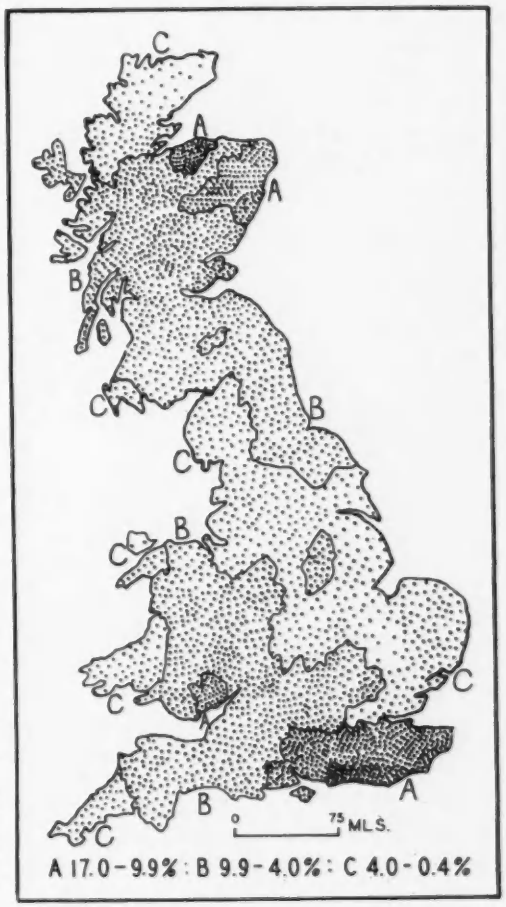

FIGURE 4.—Distribution of woodlands in Britain by counties. Percentage area and distribution of woodlands in Great Britain by counties, 1924. Each dot represents 1000 acres. (Census of Woodlands, 1924, pp. 22–46.)

Grown Timber, 1924, and the Report on Census of Production of Home Grown Timber, 1930, published in 1932, show, as Table II indicates, that the total home production of timber was 56 million cubic feet in 1924 and 48.1 million cubic feet in 1930. The total value for the latter year was computed as £1,545,000. These figures reveal the unsatisfactory state of Britain's three million acres of woodland, for the annual production therefrom appears to average about 16 cubic feet per acre in volume and 10 shillings per acre in value. It will be noted that already the annual cut of conifers exceeds that of hardwoods.

TABLE II

HOME PRODUCTION OF TIMBER AND IMPORTS OF TIMBER AND PULP OF WOOD, 1924 AND 1930

In million cu. ft.

	Conifers		*Hardwood*		*Total*	
	1924	*1930*	*1924*	*1930*	*1924*	*1930*
Net imports of timber and pulp of wood	906.4	967.6	74.7	84.5	981.1	1,052.1
Home production of all descriptions	30.9	26.4	25.1	21.7	56.0	48.1
Total consumption	937.3	994.0	99.8	106.2	1,037.1	1,100.2
Home production as percentage of total consumption	3.3	2.7	25.2	20.4	5.4	4.4

Census of Woodlands, 1924, p. 62, and Census of Production of Home Grown Timber, 1930, p. 11.
Conversion figure: One load unmanufactured timber = 50 cubic feet standing timber
One ton pulp = 100 " " " "

PRODUCTION IN RELATION TO CONSUMPTION

Expressed in terms of standing timber, the home production of timber, and imports, not including imports of wood manufactures, are shown in Table II.

The table shows that Great Britain produced rather more than one-quarter of her total requirements of hardwoods for 1924, but only one-thirtieth of her requirements in softwoods. It will be observed, however, that the total quantity of hardwoods required is only a fraction of the requirements in softwoods. The total amount of home produced hardwoods and softwoods together was only 5.4% of the total requirements.

The figures for 1930 show that while imports of hard and soft woods increased materially, the home cut of both declined materially. The total home production was only 4.4% of the total consumption—revealing the remarkable fact that *on the present basis of yield per acre, Britain would not be self-supporting in timber were its entire area under forest.*

The general position in relation to home production and imports can change only gradually, but it is safe to say that if the present position in planting and felling is maintained, the supply of hardwoods sooner or later will seriously decline, while the available softwoods will increase. At present, little difference exists between the estimated volume of hardwoods and conifers in Britain's woodlands, as shown in Table III, which does not include hedgerow timber and uneconomic woods.

TABLE III

ESTIMATE OF CONTENTS OF BRITAIN'S WOODLANDS, 1924

Million Cubic Feet

Saw timber sizes:		
Coniferous	748	
Hardwood	798	
		1,546
Pitwood sizes:		
Coniferous	374	
Hardwood	342	
		716
Total		2,262

Census of Woodlands, 1924, p. 15.

The difference in consumption of hardwoods and softwoods would seem to suggest the planting of conifers almost to the exclusion of hardwoods, but it must be borne in mind that the timber used in rural Britain has always been from broad-leaved species, and that English oak and ash hold their own in the market against outside competition. On the other hand, only one coniferous

tree is indigenous to Britain—the Scots pine—and some of the exotic species now widely planted are virtually unproved in relation to conditions in Britain. Also the actual marketing of home produced coniferous timber at times proves a problem, as some species are not regarded with favor.

PRODUCTION AND INCREMENT

It is of the utmost importance to compare production of timber with the estimated annual increment, to see whether the timber shortage is likely to be ameliorated or aggravated by present cuttings. Table IV shows that fellings (i.e. production) exceeded increment.

TABLE IV

ESTIMATE OF ANNUAL INCREMENT AND PRODUCTION OF TIMBER IN GREAT BRITAIN, 1924

	(a) *Million Cubic Feet*		(b) *Cubic Feet per Acre*	
	Increment	*Production*	*Increment*	*Production*
1. High forest:				
Conifers	26.0	27.6	31.6	33.5
Hardwoods	11.5	15.8	19.4	26.6
2. All types	43.6	56.0	14.7	18.9

With the development of forestry along present lines in Great Britain, the discrepancy between increment and production of softwoods may disappear, but as already indicated, unless there is some considerable change, the gap between increment and production of hardwoods will increase steadily.

PRODUCTION BY COUNTRIES, 1930

The greatest contributor to the total production of 48.1 million cubic feet in 1930 was England, with a total of 26.4 million cubic feet. Scotland came next, producing 16.4 million cubic feet. These figures represent a decrease in volume of 25.7% and 12.0% respectively in 1930 as compared with 1924, but in Wales the production for 1930 was 36.3% higher than in 1924. England was naturally responsible for the bulk of the hardwood, producing 76.3% of the oak and 65.5% of the beech, while Scotland supplied 68.7% of the pine and 63.9% of the spruce. This difference between the woods of Scotland and England constantly emerges, and reflects to a great extent difference of climate, elevation, and soil conditions.

The value of the timber produced in England in 1930 was more than twice the value of that produced in Scotland, approximate figures being £984,000 and £405,000 respectively. Wales produced timber valued at £156,000.

PRODUCTION BY FOREST TYPES

The whole of the timber produced does not come from high forest. Hedgerow timber alone in England accounts for about 5% by volume of the

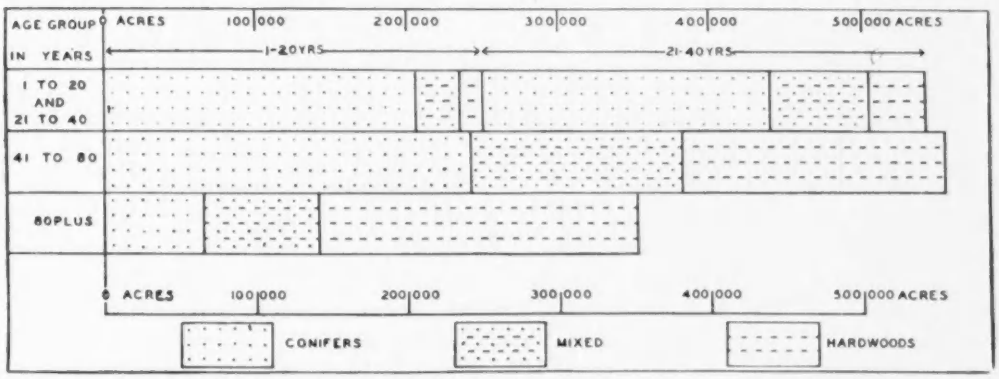

FIGURE 5.—High forest age distribution in Britain, 1924. Diagram to show distribution of high forest by age groups in Great Britain, 1924. Note the lack of hardwoods in the group 1–40 years.

TABLE V

VALUE AND VOLUME OF GREAT BRITAIN'S TIMBER PRODUCTION, 1924, BY FOREST TYPES AND COUNTRIES

Volume: Million cu. ft. *Value:* £000

	England	*Wales*	*Scotland*	*England*	*Wales*	*Scotland*
Total, including coppice, scrub, uneconomic, hedgerow, etc.	30.0	3.8	22.1	1,329.6	143.9	562.6
High forest production	19.3	3.3	20.7	937.9	125.8	533.8

total production, and a greater percentage by value. Elm is probably the most important species in this connection. Little hedgerow timber grows in Scotland, and the average for Great Britain by volume and value is about 3%. Table V for 1924 shows the contribution made by high forest to the total production in the three countries. It will be noted that in England high forest is relatively less important, and this is due to the considerable importance of coppice woodlands, hedgerow timber, etc. This is not the case in Wales and Scotland.

PRODUCTION BY CLASSES OF MATERIAL AND SPECIES

Figure 6 shows the contribution made to the total production of timber in Great Britain (1930) by different classes of material. The bulk, namely 30.1 million cubic feet out of 48.1 million cubic feet, is timber of sawmill size. Firewood comes next with a surprising total of 7.4 million cubic feet, and smaller material next with 6.4 million cubic feet. Softwoods contribute more than hardwoods. Of softwoods, pine was easily the most important, accounting for 11.4 million cubic feet out of 26.4 million cubic feet. Larch and spruce were also important. Among hardwoods, oak ranked first, accounting for 8.1 million cubic feet out of 21.7 million cubic feet. Beech came second and elm third. More than one-half of the sawmill softwood was pine, and almost one-half of the sawmill hardwood was oak.

On the basis of value, timber of sawmill size was responsible for about two-thirds of the total. The total value of hardwoods exceeded the total value of softwoods by £124,000, for while the average price per cubic foot for softwoods was 5½d., that for hardwoods was 7½d. The value of larch just exceeded that of pine, but among hardwoods, oak has more than three times the value of any other species. For timber of sawmill size, ash fetched highest average price at 1/9d. per cubic foot, oak second at 1/3d., and larch third at 11½d. These prices for 1930 are much lower than those quoted for 1924.

THE STATE AND AFFORESTATION

From the foregoing facts it will be seen that for many years a real need for a virile forest policy has existed in Britain. The immediate cause of a comprehensive scheme of afforestation arose out of the experience of the Great War. Imports were restricted because of the large tonnage of ships involved. In 1915, the imports of timber were three-quarters of the normal pre-war imports, and in 1916 they were two-thirds of that amount. Yet the total cost was £37,000,000 in excess of pre-war values, and tonnage was absorbed in the timber trade that was needed for carrying food supplies. It was felt that for reasons of national security an effective scheme must be devised to produce a supply of timber within Britain, even if a reasonable financial return could not be guaranteed. A report, commonly referred to as the Acland Report, was drawn up by a Forestry Sub-Committee of the Reconstruction Committee, under the chairmanship of the Rt. Hon. F. D. Acland, M.P., and this report furnished the starting point for State entry into

afforestation on a large scale. The aim of the scheme was, briefly, to produce one-fifth of the annual timber requirements of the United Kingdom, so that in time of crisis, such as war or boycott, by drawing upon the normal production of 15 years the Kingdom would be made self-supporting during a period of three years.

As already indicated, the State had previously been by no means oblivious of the situation in regard to home timber supplies, but less than 3% of the woodland area actually remained under State control in Crown Forests, and the price of foreign timber did not rise sufficiently high to affect seriously the management of privately-owned woods. In urging an adequate forest policy for the Kingdom, the Acland Report gave three reasons:

(1) That dependence on imported timber was a grave source of weakness in time of war.

(2) That supplies of timber even in time of peace, were precarious and lay too much outside the Empire.

(3) That afforestation would increase the productiveness and population of large areas of the British Isles, then little better than waste.

The first reason is perhaps the least important from the point of view of purely economic geography. We may note, however, that the question of supplies of calcium acetate, acetic acid, and acetone, all of which could be produced from forests in Britain, was also involved, and that the value of imports of these in 1915 was nearly a million pounds.

The second reason advanced demands more serious consideration. It involves recognition of the world's decreasing area of virgin forest and diminishing reserves of softwoods. Before the War, the United Kingdom derived 60% of its timber from the virgin forests of

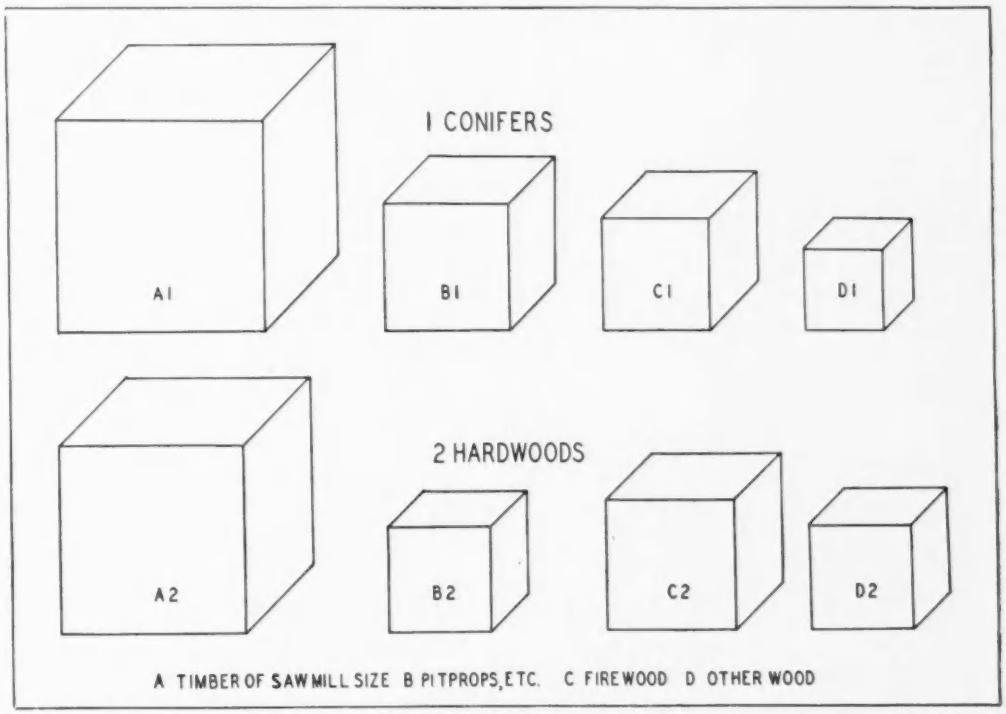

FIGURE 6.—Timber production in Britain, 1930. Volume of timber produced in Great Britain, distinguishing different classes of material. (Census of Production, 1932, p. 5.)

FIGURE 7.—Hauling logs, western Canada. Canada is the only part of the British Empire which possesses a big reserve of softwoods. (Courtesy High Commissionery for Canada, London.)

foreign countries, almost half the total imports coming from Russia. The habit of considering imperial resources as materially different from foreign resources is open to question, but so far as there is a significant difference it is worthy to note that the proportion of timber derived from Empire sources fell from 22% in 1899 to 10% in 1913. The only country within the Empire having a surplus of all-important softwoods is Canada (Figure 7), and exports have been increasingly diverted to the United States, as shown by Table VI.

India, South Africa, Australia, and New Zealand were already importers of softwoods in pre-war days.

in Great Britain, 12.8 million acres were below 1,500 feet in altitude, and hence available for selection of afforestation areas. Five million acres in Scotland and one and a half million acres in England and Wales were considered capable of producing timber.

In Scotland particularly, exist many large areas of virtually uninhabited country, which can undergo no agricultural development unless accompanied by subsidiary occupations to which people can turn to increase their means of earning a livelihood. In some parts, quarrying, fishing, and weaving help. In others, it is felt that forestry would provide suitable subsidiary occupations, particularly as it is permanent in character, and fits well into agricultural labor-economy, the bulk of the work falling in the winter months. The population capacity of these virtually waste lands should, therefore, increase, helping to stem rural depopulation. A thousand acres of hill grazing require the services of only one or two shepherds, and the annual production on the best of this land is less than ten pounds of mutton and two pounds of wool per acre. The same area under forest requires the services of ten men, besides occasional labor and such labor as may be employed in industries dependent on

TABLE VI

CANADA: AVERAGE ANNUAL VALUE OF EXPORTS OF WOOD, WOOD PRODUCTS AND PAPER IN $000

Years	*To U. K.*	*To U. S.*	*To Other Countries*	*Total*
1891–1892	10,703	12,265	1,417	24,385
1898–1902	13,505	11,012	1,952	26,469
1908–1912	13,411	33,807	5,957	53,175
1913–1917	14,542	54,697	5,754	74,993
1918–1922	22,538	149,137	18,196	189,871

Fourth Annual Report of the Forestry Commissioners, p. 33.

The third reason, which concerns economic utilization of land practically waste, is of extreme importance, quite apart from strategic or imperial questions. The Royal Commission on Coast Erosion and Afforestation estimated that of 16.3 million acres of deer forest, rough grazing, and heath land the forest, and the production at a low estimate is 50,000 cubic feet of coniferous timber per annum. When woods extend to thousands of acres, they justify the building of roads, railways, telegraphs, sawmills, pulpmills, wood distillation plants, etc., all potent in the development of the district, bringing

many of the amenities of life to otherwise solitary crofters. It was recommended that no land fit for permanent agricultural purposes should be used for forestry, but rather that forestry should increase the area of arable land by making possible small holdings in the districts previously too isolated. Such small holdings have become an important and interesting feature of afforestation in Britain.

Two other aspects of afforestation are worthy of mention, namely rain run-off and enclosure. The first of these is not a question of soil erosion, so frequently associated with deforestation, for the areas under consideration often bear a peaty turf, and erosion is negligible. It is concerned with floods, which are periodically a source of expense and anxiety in some thickly populated districts, such as the Lower Thames and Severn Basins. The afforestation of well-chosen districts may well regularize run-off, and decrease the liability of these rivers to flood. Many cities have already afforested with conifers parts of the catchment basins of their water supply (for example about Thirlmere, Vyrnwy, and Eland Valley), in order to maintain a purer, steadier inflow.

The second aspect of large scale State afforestation concerns the enclosure of the forestry units. Hitherto, tracts of upland grazing, the type of land which is likely to go to forest, have always been open to the public as recreation grounds. When taken over by the State, fenced and planted, are they to be closed to minimize risk of damage, especially from fire? This is a serious matter to dwellers in congested urban areas who seek the country for recuperation. To deny them the privilege of access is to take away an economic function which such country was coming to fulfill more fully every year. It is hoped to create such a forestry sense that national forests will not be endangered by public liberty and that all State forests may become national playgrounds, as Epping or the New Forest are today. In many of the new forestry units it is not forbidden to wander at will, but the forester naturally does not welcome the responsibility which such liberty involves. Where coniferous planting has been in progress on an extensive scale for a number of years, the former wide open spaces are clothed with dark green plantations that look far from inviting with their close-growing trees.

AREA TO BE AFFORESTED

After considering in turn the area of existing woodlands, the possible increase in productivity of these under better management, and our imports and increasing consumption, the Committee came to the conclusion that it was desirable to afforest a further area of

FIGURE 8.—Deciduous woods inplanted with conifers. Much of Britain's deciduous woodland is being replaced by conifers. The transformation is here seen in progress in Eskdale, Lake District, Cumberland.

1,770,000 acres with conifers, and 100,000 acres with hardwoods. Plenty of land exists from which to select the area for softwoods, but hardwoods require more fertile soil, and to find such an area may mean an encroachment upon agricultural land, a course which could not be recommended. The suggestion was made that devastated woodland could be used for the purpose, and statistics elsewhere in this article show that there is no shortage of that in Britain.

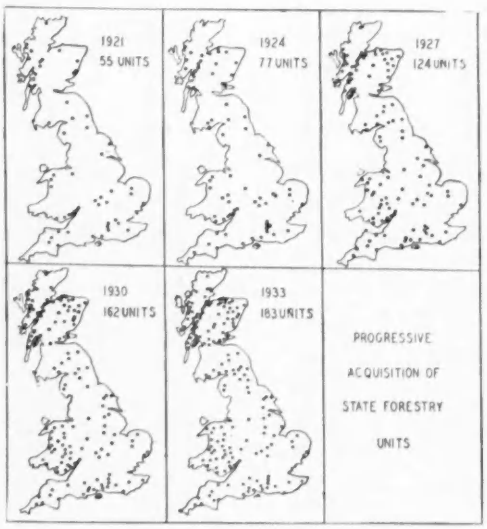

FIGURE 9.—Acquisition of forestry units by the state. The map series shows the wide distribution of state forestry units in Britain, and the increase in number triennially since 1921. Units vary in size, the majority being between 1,000 and 4,000 acres in extent. The map for 1921 includes sixteen Crown forests, not formally taken over by the Forestry Commissioners until 1923.

The policy threatens materially to alter the woodland typical of Great Britain. Of conifers, the Scots pine alone is indigenous, and though the chief tree in Scotland, it was never of great importance in England. Larches, firs, spruces, thuyas, cypresses, cedars, and numerous pines have been introduced, but these did not greatly affect the character of woodlands till towards the end of the nineteenth century. English woodlands are typically of broad-leaved deciduous species—oak, ash, elm, beech, walnut, chestnut, and sycamore, with an undergrowth of hazel, elder, and birch. All who have lived in England and watched the changing beauty of these woods with the changing seasons must regret that political and economic policy converge towards the replacement of broad-leaved species by dark rows of close-growing conifers. The numerous small patches of deciduous woodland have been a great feature of the English landscape, relics of the time when the lowlands were almost completely forested; now almost everywhere is seen an in-planting of conifers (Figure 8). There finally must follow to a great extent the disappearance of the greater part of our deciduous woods, and with them the small rural industries which have for centuries been based upon a supply of local hardwoods. There is a great deal to be said (see Stebbing, E. P., "The Forestry Question in Britain," pp. 92–120) for maintaining all areas, no matter how small, which possess suitable forest soils, in broad-leaved timber, especially oak and ash. Elm is produced mainly as hedgerow timber. In short, the aesthetic and cultural points of view merit consideration, and have a definite, though not necessarily a marketable, value. They were likely to be overlooked in war time.

Botanists are concerned because they feel that many wild plants, characteristic of open deciduous woodland, will disappear from our countryside, for even hedgerows around small fields are being uprooted to enlarge the cultivable area, and to allow the use of large agricultural machinery.

FINANCE

The commission admitted the difficulty of arriving at anything like an accurate forecast of the cost of planting the required area of 1,770,000 acres,

but suggested that two-thirds of this area could be planted in the first 40 years at a cost of £18,425,000, a sum less than that lost through importing timber at greatly enhanced prices during the first two years of the War. It was believed that after 40 years the return from forest products would make the scheme financially self-supporting.

The financial return on the outlay depends upon cost of production, and the amount of money realized. Cost of production includes the cost of land, planting, supervision, and rate of interest on money invested. The last consideration is of great importance, since the period of rotation extends to 80 years for softwoods and still longer for hardwoods. The money realized depends upon the volume of wood, and the price obtained. Estimates were based on a mean production of 70 cubic feet per acre per annum, while it was recommended that no land incapable of producing 40 cubic feet per acre per annum should be afforested. It is illuminating to place these figures side by side with production just before the War. The total area of woods in the United Kingdom was then estimated to be 3,043,300 acres and the production, including hedgerow timber, was 30 million cubic feet of conifers, and 15 million cubic feet of hardwoods—which works out at less that 15 cubic feet per acre per annum. By contrast, German state forests in Baden produced 90 cubic feet per acre per annum.

FIGURE 10.—Forests of the future. Thousands of conifer seedlings commence growth on fertile tracts in Scottish glens, before being transplanted to the hills. View in a nursery near Fort Augustus, Inverness.

THE PROGRESS OF AFFORESTATION

We now turn from the results of six centuries of deforestation to the work accomplished in a decade and a half of afforestation—based on the Acland Report. The Forestry Act of 1919 gave the necessary powers, Forestry Commissioners were appointed, and work was started. Achievements have fallen short of plans only because of financial curtailments and uncertainties. Accomplishment of the program outlined in the Acland Report, namely the afforestation of 1,770,000 acres of land, and the improvement of private woodlands, remains the ambition of the Commissioners.

LAND ACQUIRED AND AREA PLANTED

At the end of 1933, the Forestry Commissioners possessed, or had entrance to, 274,166 acres of plantable land in England and Wales, and 181,054 acres in Scotland, a total of 455,220 acres. About three-fifths of this was owned outright by purchase, the average price per acre paid during the first decade being £3.5.9. The remainder was held under lease or feu. The whole area has been acquired in units of varying size, distributed through Britain as shown in Figure 9. (Based on Annual Reports of the Forestry Commissioners, and drawn by permission of the Controller of H. M. Stationery Office.) As occasion offers, adjoining land is secured, and units enlarged. Of 152 forest units held at the end of the first decade, three exceeded 8,000 acres of plantable land, while twelve were under 500 acres each. The bulk were 1,000–4,000 acres. New units are not readily started unless there is the likelihood ultimately of raising the area at least to the 1,000-acre margin.

Table VII shows at a glance the area that had been planted by September 1933.

Of the total area of new plantings, 207,923 acres were planted with conifers, and 11,663 acres, or approximately 6% with hardwoods. In addition to the above area afforested directly by the State, during the same period 95,228 acres were planted by State aid.

Variations in the program, which is outlined by decades, are introduced mainly by incidence of financial stress and resultant modifications of policy, and by the formulation of schemes to absorb more labor, at which times afforestation finds favor.

SEED SUPPLY

The Commissioners have sown annually some 10,000 pounds of coniferous seed, and from 2,000 to 131,000 pounds of seed of broad-leaved species. Coniferous seed has been obtained from all parts of the world, particularly from indigenous species which the Commissioners seek to develop in Britain. Among important contributors have been the U. S. A. and Canada (especially for Douglas fir and Sitka spruce), Corsica, Japan, and European countries. A considerable quantity of home seed has been obtained, particularly of Scots pine and European larch. Almost the entire quantity of hardwood seed has been produced in Britain. As the seed crop of certain species is markedly irregular, recourse has been had to seed storage, with very little loss of germination capacity, in hermetically sealed glass carboys. A very pleasant feature has been the receipt of gifts of seed from

TABLE VII

STATE AFFORESTATION, 1919–1933

(In acres)

	Proposed	*Actually Planted*		
		New Plantings	*Replacements*	*Total*
First decade, 1920–1929:				
Conifers	150,000	125,799	4,969	130,768
Hardwoods	Unspecified	5,774	1,737	7,511
				138,279
Second decade	353,000			
Allotment for 1930–1933	90,000	88,013	6,419	94,432
Totals		219,586	13,125	232,711

Fourteenth Annual Report of the Forestry Commissioners, p. 4. Owing to financial difficulties, the proposed program for the second decade has been modified to 20,000 acres per annum minimum.

no less than nineteen countries widely separated as Chile, Turkey, New Zealand, and Japan.

THE NURSERIES

So far as practicable, each forestry unit has its own nurseries, and so the cost of transporting plants is minimized. In Scotland the nurseries commonly occupy a few acres of alluvial soil in the bottom of the glen which is itself the nucleus of a forestry unit (Figure 10). There are different methods of soil preparation. At one of the largest nurseries near Fort Augustus, the soil is ploughed, treated with fertilizers, and sown to oats. These are ploughed in green, the soil is allowed to remain a year, and then seeds are sown in rows six to nine inches apart. Experimental work on soil preparation, effect of texture, density of sowing, transplanting, etc., are constantly in progress. In general, plants remain in the seed beds for two years, and are reduced in numbers by frost, birds, and pests. The seedlings are then graded and transplanted and at the end of four years are ready to go out to the hills. Under some conditions, direct sowing has proved successful. The Commissioners were fortunate in that they did not have to wait for four years before planting out could commence. As early as 1915, the Crown Nurseries, then some 30 to 40 acres, were enlarged and emergency seed sowing commenced, as an initial step to provide a supply of plants for eventual afforestation purposes. By 1919, the Commissioners had in Great Britain about 250 acres of nurseries, and the figure has gradually increased to nearly 1,000 acres, estimated to contain in various years from 133 million to 298 million seedlings, and 43–118 million transplants. The number of conifers always exceeds the number of hardwoods by a big margin.

LAND PREPARATION AND PLANTING OUT

When the plants have reached a certain age, or stage of development, they are ready to plant out. As most of the larger forest units produce their own seedlings, the broad choice of species will have been made beforehand, dependent upon the type of district and the

FIGURE 11.—Fire danger. Young plantations are menaced by fire, particularly in times of drought. The picture shows rank undergrowth of bracken and heather, and an official Fire Danger notice. On the left is a pile of besoms with which to beat out fire. The deer fence is unusually low. Taken in Glen More, Scotland.

variety of conditions common within that district. Figure 9 shows that forestry units range from the very north of Scotland to the Isle of Wight, from an altitude of 1,500 feet to sea level, and from the hard old Palaeozoic hills of Wales to the chalklands and sandy areas of southeastern England. The chalklands are suitable for beech, the sandy areas for Scots and Corsican pines,

bracken-covered slopes for quick-growing conifers such as Douglas fir and larches, and the poorer hill pastures for Norway and Sitka spruces. Experimental work is necessary before the value of extensive peat areas can be determined. Growth on the whole appears very satisfactory where conditions suit the species planted. In the early years there was a tendency to overestimate the quality of land and to plant species which were too exacting. Within a decade, poles 25 and 30 feet have been cut for exhibition.

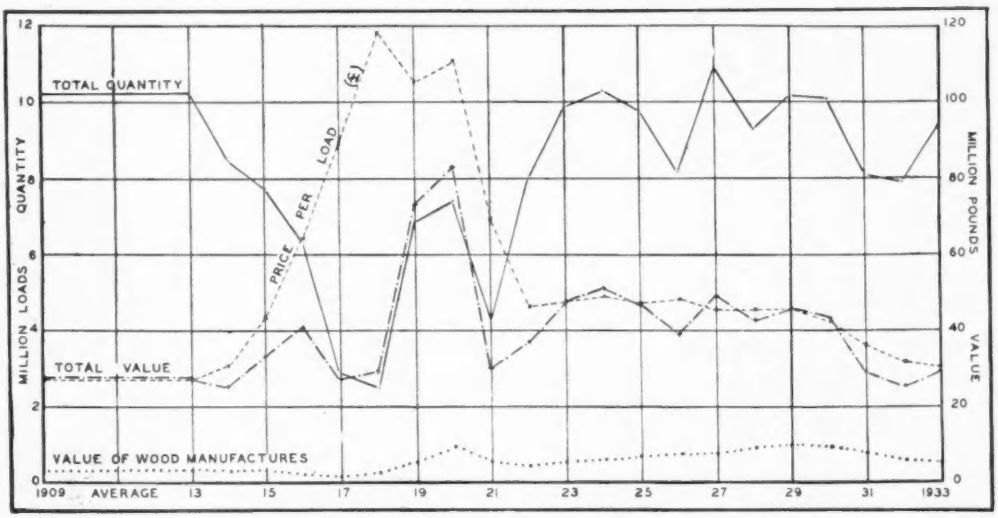
TOTAL QUANTITY
PRICE PER LOAD (£)
TOTAL VALUE
VALUE OF WOOD MANUFACTURES
MILLION LOADS QUANTITY
MILLION POUNDS VALUE
1909 AVERAGE 13 15 17 19 21 23 25 27 29 31 1933
0 2 4 6 8 10 12
0 20 40 60 80 100 120

FIGURE 12.—Imports into the United Kingdom of manufactured and unmanufactured wood, 1909–1933. The bottom line of the graph shows the value of manufactures of wood imported into the United Kingdom, and the other three lines show the value, price per load, and total quantity of imports of unmanufactured timber.

It is interesting to note that the safest guide to assign a given species of tree to a given area, is the natural vegetation. This to a great measure indicates the combined effect of climate, elevation, soils, and drainage. Significant plants are heather, bracken, molinia, juncus, and scirpus. No matter how often natural vegetation may vary from place to place over a few acres of land, the area must be planted up accordingly with suitable species, if the best possible results are to be obtained. In some districts, large areas were planted up in the early years of State afforestation, and today only a few patches survive here and there where conditions suited the particular species. This kind of experience is expensive.

As a rule, land needs some kind of preparation before planting commences. The cost of fencing against such pests as rabbits and, in Scotland, deer, is often great. Fences against deer commonly exceed six feet in height and have as many as twelve lines of strong wire. Much land in the wet western peaty districts, even where the slope is steep, needs draining, and channels about nine inches wide and a few inches deep are cut at frequent intervals. Often there is a rough growth of grass, heather, ling, and bracken which not only tends to strangle the young plants, but proves a menace in spreading fire (Figure 11). This growth is sometimes burnt off, but in areas already partly planted burning is discouraged because of the risk. In some areas a strong plough has been used to break up the surface, and there has been constant experiment with peaty areas, both as regards soil treatment and

adaptable species. Occasionally there are patches of ill-grown deciduous trees, which make no contribution to timber production, nor do they even offer shelter for the growing plantations. Such trees are killed by cutting away a ring of bark, and are left standing.

The actual operation of planting out is commonly conducted by gangs of five to ten men. They may be supplied with plants by boys or may fetch their own from prepared dumps. Practice soon does away with artificial aids to alignment. Methods differ, but on most land a sod is cut and turned over, and the plant firmly set in the inverted sod. Plants are placed from four to eight feet apart, with a view to thinning later. Each man plants out about five hundred daily. Some may plant almost twice this number, but the quality of the work tends to suffer. Direct sowing of seed has in places proved successful. The cost from 1919 to 1933 for preparation of ground, drainage, fencing, plants, planting, replacement of failures, and weeding, but not including forest protection, supervision, and overhead charges, averaged £9.8.11 per acre. Nurseries represented 28.6% of this cost, planting 15.2%, fencing and cleaning each 13.1%, preparation of ground 8.2%, drainage and forest protection each 8.1%, and replacement of failures 5.6%. The number of failures varies to a certain extent with the weather. In 1933, drought caused many newly-established plantations to suffer, especially on the clay soils of southeastern England. Plants on land prepared with the plough withstood the drought satisfactorily. Older plantations of European larch, Douglas fir, Norway and Sitka spruces, in the north and west of Britain showed improved growth due to the higher summer temperatures.

Species Planted

In round figures, about 544 million trees have been planted in the period 1919–1933. This number includes those used in Crown Woods as they came under the Commissioners' control, and the very considerable number of replacements. Conifers outnumber hardwoods by 492 millions to 35 millions; 17 millions are unspecified, and include a variety of species. Scots and Corsican pines are the leading species numerically, totalling 223 millions, with Norway and Sitka spruces a good second, accounting for about 161 millions. European and Japanese larches are a poor third with about 69 millions, and Douglas fir follows with 39 millions. Oak and beech lead the hardwoods with roughly 15 millions each, while ash accounts for nearly 6 millions. Plantings in all species, grouped as above, are greater in England and Wales together than in Scotland, with the exception of Norway and Sitka spruces. Very few hardwoods have been planted in Scotland, beech being used most often.

Forest Fires

These young State plantations create a new problem—that of protection from fire. Though a menace to the timber resources of countries in nearly all parts of the world, forest fires are unusual in Britain where prolonged drought is infrequent, and the woods, consisting mainly of widely spaced deciduous trees, are rarely extensive. But the new plantations frequently have much undergrowth, and the trees, which are mainly coniferous evergreens, are planted close together over large areas. The danger of fire under these circumstances does not diminish when the trees have produced a canopy which kills the undergrowth, and the loss is likely to be considerable. So far, the number of fires

has varied largely with the degree of drought. In 1929, for example, severe frost was followed by a lack of rain later in the year, and 409 fires were reported. An area of 4,574 acres was involved and the damage was estimated at £45,961. This may seem trivial when compared with forest fires as known in Canada and U. S. A., but it must be remembered that in that particular year the State had in all only 202,744 acres of forest. The chief cause of forest fires is undoubtedly sparks from railway engines, to which are attributed about half the total. To minimize fire danger, as well as for aesthetic reasons, deciduous trees, such as beech, are commonly planted along road sides. Bundles of besoms (birch twig brooms) for beating out fires are placed beside paths and roads. Youth hostels, which commonly stand on the Commissioners' land, are also well billed with notices of the danger of fires. In this way, town dwellers who frequent the country are made to realize, often for the first time, that fire can be a menace to forests in Britain.

TABLE VIII

NUMBER OF MANUAL WORKERS EMPLOYED

Summer (Minimum)		Winter (Maximum)	
1920	210	1920–21	935
1922	525	1922–23	1,175
1924	1,620	1924–25	2,650
1926	2,335	1926–27	3,185
1928	2,740	1928–29	3,565
1930	3,130	1930–31	3,850
1932	2,720	1932–33	3,985

Fourteenth Annual Report, p. 39.

The fact that afforestation could make some contribution to relieve unemployment was felt from the outset, and in the early years of their work the Commissioners proposed speeding up to create rural employment. Then, in 1924, a scheme was evolved to create small holdings on afforestation units, a system preferable to temporary employment schemes. It was proposed to establish small holdings of not more than 10 acres each of agricultural land, and not more than five such holdings per 1,000 acres of land. Tenants were to be guaranteed a minimum of 150 days' work per year in the forests. The first holdings were ready by the end of 1925, and at the end of 1929, 618 were complete. Definite advantages have become apparent. The main object has been to provide, under sound living conditions, a body of skilled workers whose interests are closely identified with those of the forests. Small areas of good land, such as are frequently found in connection with hill and heath, have been better utilized. There has been a

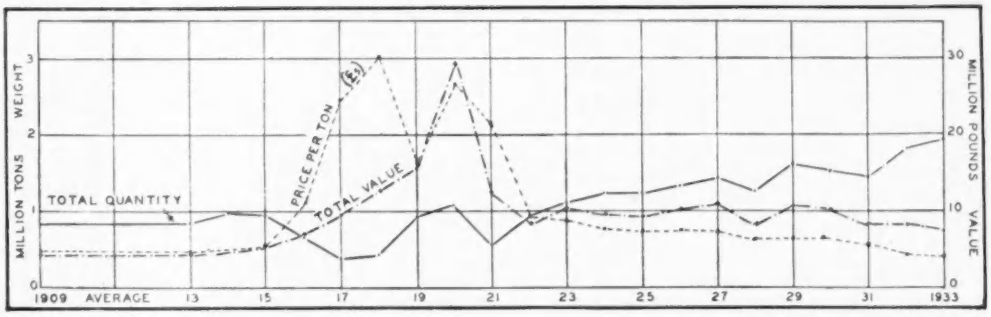

FIGURE 13.—Imports into the United Kingdom of woodpulp, 1909–1933. The graph shows the value, price per ton, and total quantity of pulp of wood imported into the United Kingdom.

EMPLOYMENT, FOREST WORKERS' HOLDINGS, AND EXPENDITURE

The number of manual workers employed in the Commissioners' forests varies with the season, being greatest in the winter. Table VIII shows the number for alternate years since 1920:

flow of capital into rural areas, a tendency to check rural depopulation and in some cases a marked rejuvenation. The cost, which involves building new houses or reconditioning existing ones, has been kept at about £500 which includes the value of the land. Rents have been fixed at about £15.10.0 per annum, so that the financial return is 2% to 3%.

The success of the scheme and its possibilities as one means to diminish unemployment in a wholly satisfactory manner was such that in the second decade (1930–1939) it was proposed to establish 3,000 holdings, 350 in each of the first five years, and 250 in each of the second five years. But financial stress again made itself felt and the number completed in 1933 was 42. Nevertheless, during the whole period, 1,198 forest workers' holdings have been completed, and the demand for holdings is good. The number of forest workers resident on the holdings in 1933 was 1,165, and the total number of residents, nearly 5,000. The estimated value of livestock exceeded £43,000. Many of the holders look for, and have obtained so far, almost full-time forest employment. As the age of the forest increases, the amount of labor needed will increase also. It is fortunate in this respect that the period of maximum demand for labor in the forest is greatest in the winter, and least in the summer when the forest holder needs most time on his own land. Afforestation is, therefore, contributing in more ways than one to the national wealth of Britain, as predicted in the Acland Report.

During the first decade, the net payments made by the Commission amounted to £3,650,534, agreeing closely with the expenditure suggested in the Acland Report, though the area planted fell short by nineteen thousand acres. The expenditure includes the whole of the Commissioners' activities including such items as advances for afforestation purposes to private landowners, and education. The gross payments over the whole period from 1920–1933 amounted to 7½ million pounds, while receipts from all sources were 1½ million pounds, so that the land acquired and the work accomplished has cost six million pounds. Cultural operations are responsible for 42.5% of the total cost, and acquisition of land stands next at 23.8%. The chief source of income has been Forest Produce, accounting for

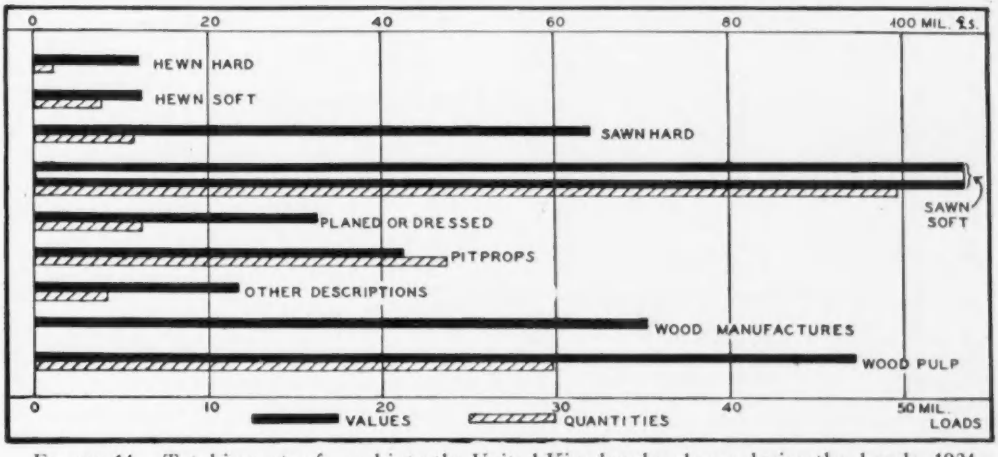

FIGURE 14.—Total imports of wood into the United Kingdom by classes during the decade, 1924–1933. Values and quantities of the various classes of wood which entered the United Kingdom during the decade 1924–1933. The total value of wood manufactures is relatively small.

39.7% of the total, with rents and royalties next at 35.4%. In time, the whole scheme should become self-supporting, and then commence to yield a profit.

THE PROBLEM OF PRIVATE WOODLANDS

By the end of 1924 State forests, including plantable ground purchased, together with all former Crown forests, accounted for 6.7% of the total woodland of Great Britain. Corporate bodies owned 1.4% and the bulk, 91.9%, roughly 2¾ million acres, belonged to private individuals. The whole of this area is not, of course, actually producing timber. The opinion expressed in the Census of 1924 (p. 17) is that the area of effectively productive woodland in private ownership is unlikely in future to exceed 1½ million acres. Any further acreage deemed essential for the welfare of the country must be planted by the State. There is evidence from the Censuses of 1905 and 1913–14, though these are not directly comparable with the 1924 Census, that the total area of woodland, depending as it did mainly upon private enterprise, was diminishing. From 1884 onwards the average rate of planting had been some 12,000 acres per annum, only about half as much as was required to keep the nominal woodland area in a state of good productivity over the given rotation period.

FIGURE 15.—Jarrah, western Australia. Natural distribution of this tree is confined to a limited area in southwestern Australia. Its great merit is resistance to marine borers and the ravages of tropical white ants. (Courtesy Director Australian Trade Publicity, London.)

The State program for afforestation started by assuming that it would be able to take steps to secure the continuance of the existing woodland in private ownership, and materially to increase the yield therefrom. But the Census of 1924 (p. 48) revealed that war fellings had been greater, and that the remaining woods were of poorer character, than had been anticipated in the Acland Report. How to maintain the existing area, and above all to increase production to what may be regarded as a normal figure, remains an unsolved problem.

A proceeds-sharing scheme outlined in the Acland Report, has met with very little response, but some advantage has been taken by corporate bodies and by individuals of a system of grants in aid of afforestation and replanting. Initially £2 per acre was allowed for scrub clearance, £3 per acre for preparation of land, and £3 per acre for planting; owners could only claim under two of these headings. In 1924 the grant for planting was increased to £4.10.0 per acre. Then in 1925–26 a further revision followed, by which an allowance of £2 per acre was made for planting with conifers, £4 per acre with hardwoods, and £1 per acre for scrub clearance. This remained the basis till 1933, when further differentiation was made for species—£4 per acre for oak or ash, £3 per acre

for beech, sycamore, or chestnut, and £2 per acre for other approved species. The grant for scrub clearance was discontinued.

Instead of the 110,000 acres stated in the Acland Report as the area likely to be planted under grant schemes in the first decade, the actual area planted was 72,840 acres, and the total area to the end of 1933 was 95,228 acres.

Curtailment of State afforestation has made the Commissioners doubly anxious about the condition of private woodlands, and after taking advice they found that despite all encouragement, these were not receiving as much attention as in pre-war days. Encouragement to woodland owners, which went back to 1909, included favorable charges in respect to death duties, preferential assessment in respect to taxation, provision of grants for planting and the derating of woodlands in England and Wales. Failure to achieve the desired results is ascribed to general depression, realization of money on timber, taxation, break-up of estates, want of confidence in the future, higher wages, and speculation in timber. The Commissioners say that no useful purpose can be served by again putting forward existing proposals, and add, "In the long run, therefore, the State might have to relieve the private owner of his responsibility in maintaining the woodlands of Great Britain, and take such work in hand before the woodland conditions have been dissipated, thus avoiding irreparable devastation." (12th Annual Report, p. 7.)

IMPORTS OF TIMBER, PULP OF WOOD, AND WOOD MANUFACTURES

There remains briefly to review Britain's imports of timber, and to see from what sources she draws 95% of her requirements, for even if the highest hopes are realized in connection with afforestation, she will still require in normal periods to import 80% of her requirements, and probably more if the per capita consumption continues to rise.

PRE-WAR AND WAR-TIME IMPORTS

During the years 1909–1913 inclusive according to Statistics for the United Kingdom, which prior to April 1923 included Southern Ireland, the average

FIGURE 16.—Kauri forest, New Zealand. Kauri is the most widely known of New Zealand timber trees, and is the source of kauri gum. (Courtesy High Commissioner for New Zealand, London.)

imports of unmanufactured wood and timber amounted to 10.2 million loads (Figure 12). Under war conditions in 1914 the amount declined sharply to 8.4 million loads, and imports continued to fall till 1918, when they touched bottom at 2.5 million loads. This occurred despite the great demand for timber, largely because of the huge shipping tonnage a big import involved, and also because home supplies, such as they were, could be taxed to meet the demand.

In the same pre-war period, the im-

ports of pulp of wood amounted to 859 thousand tons, and this figure was exceeded during the first two war years, then fell to a minimum in 1917, with 387 thousand tons (Figure 13).

As imports declined, prices rose sharply. In the pre-war period, 1909–1913, the average price paid for unmanufactured timber per load was £2.7; in 1916, it was £6.4; and in 1918, the peak year for prices, £11.8. The demand for the curtailed supply of pulp of wood led to a more spectacular rise—from £4.7 per ton in 1909–1913 to £30.4 per ton in 1918.

There is no means of estimating the trend of events in the third class of imports—that of wood manufactures, during the same period, but it is significant that though the quantity must have correspondingly decreased, the price paid declined hardly at all—from £2.3 million in 1914, to £2.1 million in 1918 (Figure 12).

POST-WAR IMPORTS

As soon as hostilities ceased, imports of all three classes rose rapidly. The amount of unmanufactured timber moved from 2.5 million loads in 1918 to 6.9 million loads in 1919 and to 7.4 million in 1920, but even then it was 27% below pre-war average.

The fall in price was not correspondingly great till 1921 when imports slumped. A similar increase occurred in imports of wood pulp—from 420 thousand tons in 1918 to 1.1 million tons in 1920—an amount exceeding the pre-war average by 27%. The price per ton fluctuated markedly, falling from £30.3 in 1918 to £16.4 in 1919, and rising again to £27.0 in 1920. It is clear that in treating these two classes of imports together, the dominating class will be that of unmanufactured timber. Yet despite the decreased import in this class in 1920, and the fall in price of wood pulp, the total amount paid for the two classes together in that year was £111.7 million against £31.6 million pre-war. These figures alone, quite apart from land utilization, are a strong argument in favor of afforestation. The value of imports of manufactured timber, which stood at £20.1 million in

FIGURE 17.—West Hartlepool docks. Unloading timber at West Hartlepool, where pitwood is one of the leading classes imported. (Courtesy L. N. E. Railway Co.)

1918 rose to more than twice this amount in 1919, and more than double again in 1920 (Figure 12).

Unmanufactured timber imports showed a sharp decline in quantity in 1921, and again in 1926, the latter resulting from the coal stoppage, there being a decrease of about 40% in the quantity of pit props purchased. Not till 1927 did the imports of unmanufactured timber appreciably exceed in quantity the pre-war average, and there seems no general tendency to go far outside the 8–10 million load limits. The average price per load fell rapidly from 1920 to 1922, and since then has showed a slight downward tendency, so that at present, the position in regard to imports of unmanufactured timber in quantity, price, and therefore also in total value, does not differ from the pre-war position.

Imports of wood pulp on the other hand, have shown a marked tendency to increase in amount year by year, and are now double the pre-war average, and show every possibility of exceeding the 2 million ton mark. The price per ton, however, after early post-war fluctuations, has steadily declined since 1922, till it has fallen below pre-war average. The total value of imports of wood pulp stands at roughly double the pre-war average of £4.1 million.

The value of imports of manufactured timber, following the big drop in 1921, has shown a tendency to periodic rise and fall. The bottom of the curve came in 1922 with value £3.8 million, followed by a yearly increase till 1929, when the value was £9.7 million. Since then, there has been a yearly decrease, so that in 1933 the value was £5.1 million, but this was almost double the value of pre-war imports in this class.

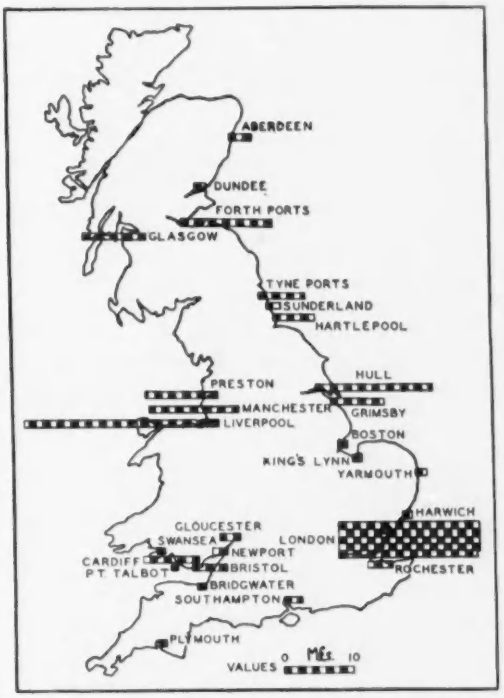

FIGURE 18.—Principal ports of entry of timber, wood manufactures, and wood pulp. All the ports shown handled upwards of one million pounds' worth of timber in some form during the five-year period 1928–1932. About forty other ports handled smaller quantities.

CHIEF ITEMS OF IMPORT

Timber production in Britain is being developed purely with a view to meet home demand, and so the types and species of timber which are consumed in Britain, and also geographically producible within the country, explain to a great extent the species planted. Figure 14 summarizes the position of all the various classes of timber entering the United Kingdom during the decade 1924–1933. (Based on summaries in Annual Reports of Forestry Commissioners.) Sawn soft woods form the principal class by quantity and by value, and are imported mainly in the form of boards, deal, and planks. The greatest single item listed in import returns, where these major classes are further subdivided, is wood pulp, with an average annual import of about one and a half million tons, equivalent to 150 million cubic feet of standing timber. Material contributions to the remainder

TABLE IX

CHIEF COUNTRIES OF CONSIGNMENT OF TIMBER, 1932–1934

Values in £000

	Unmanufactured Timber	*Manufactured Timber*	*Wood Pulp*	*Total Value*
1. Finland	18,144	2,966	10,348	31,458
2. Sweden	14,518	1,907	7,561	23,986
3. Soviet Union	17,822	1,892	.....	19,714
4. U. S. A.	11,076	2,761	.....	13,837
5. Canada	9,965	945	264	11,174

Compiled from Trade and Navigation Returns.
Some 3% under this heading Wood Pulp may consist of material other than wood pulp.

are made by planed or dressed floorings, veneers, and panel wood. It is of interest to note that oak, which can be produced in considerable quantity and excellent quality in England, is the principal hardwood imported. Mahogany stands next, at less than one-half the figure for oak.

The value of the separate items fluctuates widely from year to year, but an indication of the relative positions during the decade can be given. Deal and planks lead with an annual average value of about £11 million, pulp next, at £9½ million, then softwood boards, at about £6 million, and pit props, £4 million. Other items of importance are sawn oak and planed or dressed flooring, imports of each exceeding £2 million per annum in value.

The total value of wood manufactures imported during the decade was rather more than one-sixth that of unmanufactured timber excluding wood pulp. The chief item is plywood, valued most years at from one-fifth to one-third of the total. Builders' woodwork, furniture, and cabinet ware are important.

COUNTRIES OF CONSIGNMENT

As shown in Table IX, during the years 1932–1934 inclusive, the country sending most timber to the United Kingdom by value was Finland. Sweden and the Soviet Union fell well behind, and then after another gap came the U. S. A. and Canada.

Countries sharing the timber trade may be considered in relation to the three major classes into which timber imports are customarily divided.

(*a*) *Unmanufactured Timber.* Nine-tenths of the unmanufactured timber supplied from British countries during these years, came from Canada, but all British countries together supplied only 14% of the total unmanufactured timber imported into the United Kingdom. This state of affairs has given rise to a series of British Empire Forestry Conferences, as there is a desire to foster development of the Empire as an economic unit.

A duty equal to 10% of the value of the goods is imposed on timber imported from foreign countries, except on pit props, telegraph poles, logs for pulp manufacture, and unmanufactured persimmon, hickory, and cornelwood, which are admitted duty free. Timber consigned from and produced in the British Empire is exempt from duty.

No less than sixteen foreign countries are separately listed in the Trade and Navigation returns as supplying unmanufactured timber of appreciable value, but of this number only a few are outstanding, and together account for the great bulk, as shown in Table X.

TABLE X

AVERAGE ANNUAL VALUE OF IMPORTS OF UNMANUFACTURED TIMBER INTO THE UNITED KINGDOM, 1932–34

	£000		
From: British countries..	4,372		
		Canada.....	3,321
Foreign countries..	27,309		
		Finland.....	6,048
		Soviet Union..	5,941
		Sweden.....	4,839
		U. S. A.....	3,692
Totals.....	31,681		23,841

It will be seen that the United Kingdom's great source of supply of unmanufactured timber still lies around the Baltic, the continent of North America being a secondary, but an important source. Latvia and Poland are the only other countries of importance not shown in the above table.

TABLE XI

AVERAGE ANNUAL VALUE OF IMPORTS OF WOOD PULP INTO THE UNITED KINGDOM, 1932–1934

	£000		
From: British countries...	103		
		Canada.....	88
Foreign countries..	8,562		
		Finland.....	3,448
		Sweden.....	2,521
		Norway.....	1,737
Totals.....	8,665		7,794

(*b*) *Wood Pulp.* More than one-half of the wood pulp imported into the United Kingdom comes from Finland, Sweden and Norway, as shown by Table XI. Slightly more than 1% comes from British countries.

(*c*) *Wood Manufactures.* Of British countries, Canada is again the chief contributor to manufactures of wood imported into the United Kingdom, but altogether these countries do not supply 7% of the total. Finland is closely rivalled by U. S. A., which in turn is followed by Sweden and the Soviet Union. These four contribute considerably more than one-half of the total as shown in Table XII.

TABLE XII

AVERAGE ANNUAL VALUE OF IMPORTS OF MANUFACTURED TIMBER INTO THE UNITED KINGDOM, 1932–34

	£000		
From: British countries...	368		
		Canada.....	315
Foreign countries..	5,025		
		Finland.....	989
		U. S. A.....	920
		Sweden.....	636
		Soviet Union..	631
Totals.....	5,393		3,491

Summarizing, by value, the United Kingdom draws most of her timber, pulp, and wood manufactures from northwestern Europe, especially the countries about the Baltic. Finland leads, with Sweden and the Soviet Union important contributors. Though supplies are drawn from countries as remote as Japan, Siam, and the Philippine Islands, the only other important sources are Canada and the U. S. A. Canada is the only important source of timber within the Empire, with India a poor second, supplying, especially, teak. The well-known kauri and jarrah of southwestern Australia (Figure 15) are not imported into the United Kingdom in sufficient quantities to gain important statistical recognition. They are used, in limited quantities for telegraph cross arms, mine shafts, and wagon building. Owing to its resistance to white ants, jarrah is much used in the tropics particularly in British colonies and India. The kauri pine of northern New Zealand (Figure 16) though well known because of its strength, durability, ease of working, and because of the associated kauri gum, is likewise not imported into the United Kingdom in sufficient quantities to merit special notice.

SOURCES OF TIMBER BY CLASSES

Some idea of the sources of different classes of timber can be gained from a general knowledge of the climatic distribution of species, softwood types, as a rule originating in regions of low temperature, while woods at present obtained in the tropics are dominantly hard.

The principal hewn hardwoods imported are mahogany and oak, the mahogany originating mainly in French Equatorial Africa and French and British West Africa, while the oak comes mainly from Poland. (Trade of the United Kingdom, Volume 2.) Among sawn hardwoods, oak leads easily U. S. A., supplying more than two-thirds of the total. Teak comes next, the bulk coming from British India. Mahogany, which comes third, is supplied

largely by U. S. A. Other species of sawn hardwoods come mainly from the United States and Canada.

Hewn softwoods, such as fir, pine and spruce, come, to the extent of one-quarter to one-third of the total, from the Soviet Union, followed by the United States and Sweden. The principal countries supplying sawn softwoods are, in order, Finland, Soviet Union, Sweden, and Canada, all of which supplied in 1932–1934 sawn softwoods of an average annual value upwards of £2 million. Among countries supplying planed or dressed woods, Sweden is outstanding. The Soviet Union and Finland are the chief sources of pit props and pitwood. It seems probable that in any country where timber production has been placed on a sound rotation basis, exports are likely to undergo at least preliminary stages of manufacture, but where *lumber mining* is still general, profits will be taken by immediate export of hewn wood.

PORTS OF ENTRY

More than seventy ports in Great Britain are listed separately as importing timber in one form or another during the half decade 1928–1932. (Annual Statement of the Trade of the United Kingdom, Vol. IV, 1932.) The large number of ports involved is due to the fact that timber is of considerable bulk for value, and is, therefore, shipped direct to the nearest port (Figure 17). By contrast, trade in commodities of high value for bulk is commonly focused on a limited number of ports and distribution takes place from these by rail and road. Figure 18 shows ports which handled upwards of a million pounds' worth of timber in some form during the given five years. Three points emerge. In the first place, a larger number of ports engage in the trade on the eastern coast than on the western, reflecting the fact that Britain's timber comes mainly from the Baltic. Secondly, the grouping of the ports is an evident response to regional demand for timber in the industrial areas of Northumberland and Durham, Lancashire, Yorkshire, and South Wales, and in the modern industrial region of the home counties about London. By contrast, the hinterland of Southampton needs little timber. Finally, it will be observed that in order to minimize cost of transportation, timber is carried inland as far as possible by water, hence the trade tends to concentrate on the Forth, Clyde, Tyne, Humber, Mersey, Severn, and Thames rivers.

London alone imported timber and paper making materials valued at nearly one hundred million pounds during the half decade, an amount exceeding the total value of wood imported by the eight other most important timber ports, in order Liverpool, Hull, Manchester, Preston, Glasgow, Cardiff, Grangemouth, and Grimsby. It is significant that softwood, especially sawn soft, forms the leading item of unmanufactured timber at North Sea ports, such as Hull, Grimsby, Grangemouth, and Aberdeen, though it is also the leading item at Manchester and Gloucester. Hardwood ranks high among timber imports only at London, Glasgow, and Liverpool. Pit props and pitwood are imported almost exclusively at some of the small coalfield ports, and are important items at Newport, Swansea, Cardiff, Hartlepool, and Tyneside. The leading ports handling paper-making materials, apart from London, are Preston, Rochester, and Manchester. Comparatively few ports handle large quantities of manufactures of wood, the most important being London, Hull, Glasgow, and Manchester.

AGRICULTURAL REGIONS OF ASIA

PART IX—JAVA

Samuel van Valkenburg

JAVA merits its reputation of being one of the most beautiful islands of the world. The combination of lowlands, hills, and mountains—of which the large volcanic cones are most spectacular—the luxurious vegetation, the colorful population, the excellent system of railroads, and motorcar roads, which cross the island in all directions, and comfortable hotels, make Java a favorite field of the world traveler. His interest in the island increases considerably if he understands the intricate system of economic activity which combines so cleverly the interests of natives and white men. Java, through many centuries of colonial efforts, has become a model of colonization technique; mistakes have been made, many injustices done, but the final outcome is satisfactory. One of the most interesting sides of the colonization is that of land utilization. The combination of subsistence agriculture to support the island's teeming population, with extensive commercial plantation agriculture on a scale rarely attained elsewhere, offers one of the most interesting examples of scientific land utilization displayed anywhere. The following pages will bring the geographical description and interpretation of that agricultural development.

General Description of the Island

The Northern Coastal Zone. Quite unobtrusively Java rises from the muddy coastal waters of the shallow Java Sea. A narrow mangrove belt serves as the threshold between land and water. The coastal plain is of young alluvial sediments, a deposit of the many rivers which rise in the central mountains. The process of land building still goes on; the chocolate brown color of the rivers indicates the amount of silt carried to the sea and dropped there. Floods are frequent after severe rains when the swollen rivers break through their levees and submerge large parts of the plain. Nevertheless man generally has conquered the lowland and made it an intricate system of sawahs. On the slight rise between the rivers, villages hide under fruit trees. In the eastern part of the plain the tall chimneys of sugar mills reveal the presence of capitalistic enterprises here and there; but most of the plain is surrendered to the native to raise his food. During the dry season most of the land lays bare and fallow and clouds of dust hang over the roads and give a grey color to the vegetation. When the rains start the land regains its verdant freshness and soon green rice plants dot the irrigated fields separated by narrow mud dikes which mark the individual plots.

Harbors are necessary along the coast, not only because of the densely populated plain itself but also for the fact that the very productive central basins and lowlands find their economic outlet in the north, not along the inhospitable south coast. Total lack of natural harbors forced open roadsteads till in later years Batavia and Surabaja, two great commercial centers respectively of West and East Java, built artificial harbors, which permit the ocean liners to dock. But Semarang, the main port of Central Java, still uses the roadstead of the open sea.

The size of the plain varies greatly; its widest development is in West Java

while in Central and East Java, it narrows considerably. In Rembang the limestone rocks of the hills border the coast round an old volcanic core. The general flatness is broken in two places by volcanoes, which, formerly islands, are now, through silting, connected with the main island.

The Northern Zone of Hills. Tertiary sedimentary deposits, uplifted and slightly folded as part of the Sunda anticline (see general introduction on Malaysia, ECONOMIC GEOGRAPHY, Vol. 11, No. 3) form an almost complete zone of hilly topography between the coastal lowland and the central volcanic chain. Its major expansion is in the east where two hilly belts are separated by the valley of the Solo River; the northern of these two continues across a narrow funnel-shaped strait into the island of Madura.

In this hilly zone the landscape is very different from that of the northern plain. The soils are older, and through leaching, less fertile. In many places prevail the lateritic red color. Sawahs still follow the river valleys, but the rolling divides are used for new irrigated crops. In the eastern part corn replaces rice as the most typical food grain. On the marl and limestones, teak forests with their broad leaves cover large areas; and during the dry season when the leaves are fallen, the general impression is strangely that of a winter landscape except for the high temperatures. Scrubland and pasture appear, especially in the eastern part; and in Madura grazing, such a problem in most of Java, facilitates an important livestock development. Density of population is generally low; the crowdedness of the rice-producing plain is nowhere attained; and great parts are actually almost vacant of people, a strange phenomenon on an island with such a large population.

The Central Mountain Zone. The mountain areas of Java contain a folded sedimentary base which, along the southern boundary of Pekalongan in Central Java, reaches the elevation of 4,500 feet. Most of the geologic foundation is hidden under a volcanic superstructure which gives Java its aspect of a principally volcanic island. The volcanic cones in places merge into regular chains but generally keep their individual character and stand out imposingly with their round 10,000 feet elevation gracefully dominating the surrounding lowland.

Starting from the west the Karang volcano stands out as an isolated unit, but in the residencies Buitenzorg and Priangan a double chain development is discernible through the merging of the

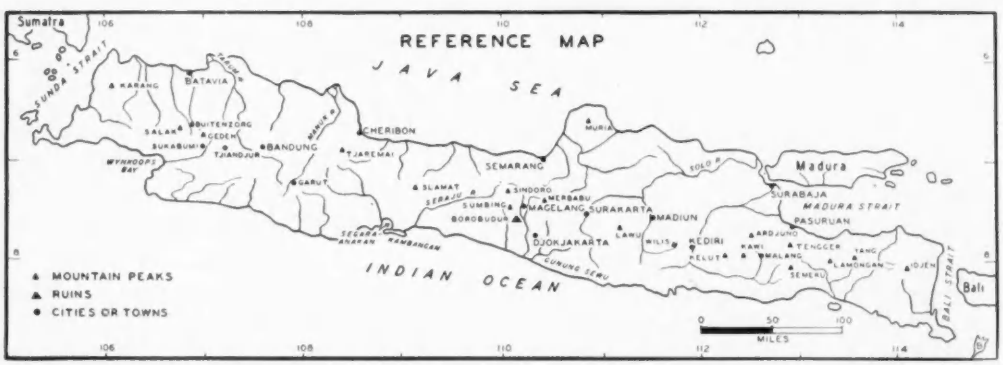

FIGURE 1.—The important place names of Java, many of them, are not so well known to American geographers and economists that a reference map of the localities mentioned in this article can be omitted.

volcanic cones leaving easy passes which occupy the depressions. The most famous is the pass between the Salak and the Gedeh leading from Buitenzorg southward. Between the two chains intermontane basins, once perhaps partly lakes, but now almost level plains, are essential features of the relief. Four are shown on the map: from west to east, the basins of Sukabumi, Tjandjur, Bandung, and Garut which are interconnected by low passes.

Higher elevation and consequently less oppressive heat, fertile young volcanic soils and plenty of rain—even during the otherwise dry season—make this zone most productive. Sawahs covers the basin floors entirely and the terraces climb high on the gradual rising slopes. The display of fruits is amazing even though some of the lowland varieties (such as the coconut) are missing. Regularly planted estate gardens crowd the remnants of the equatorial rain forest to the upper regions where, seen from above, the craters form big yellow-white holes in the green forest mantle. The whole picture is a riot of color and beauty as well as of high economic culture. Even the population looks happier, and the colorful sarongs of the women contrast with the drab dark blue garb of the plainswomen. Towns like Bandung, the potential capital of Java, and Garut have perfect location as centers of basins framed in volcanoes.

The isolated Tjaremai forms the transition towards Central Java. Here for some distance the sedimentary rocks form the mountain range, which here assumes still a double character with the Seraju River between the two wings. Not far away the volcanoes reappear in the north and crown the range. The Slamat with its 11,500-foot elevation forms a landfall visible far out on the Java Sea. On the valley bottom and on the volcanic slopes the picture is very much the same as in West Java, with irrigated rice fields dominating, but the strongly dissected non-volcanic mountain sections are less favorable to agricultural development.

In Kedu the double row of volcanoes, the Sumbing-Sindora in the west and the Merapi-Merbabu in the east enclose the most fertile Magelang basin, once the cradle of Javanese cultural and economic development and still amazingly productive. Here are the ruins of the Borobudur, a remnant of the glory period of the Buddah civilization and sufficiently restored to give a good insight into the life and customs of Java ten centuries ago.

Eastward the isolated type of volcanic massifs prevails. The Lawu, Wilis, and the Kawi-Ardjuno with the well known Kelut crater lake form mountain islands, rising out of the fertile and intensely cultivated lowlands of Surakarta Madiun and Kediri, touching in the south the coastal hilly zone. On the lowlands the rice fields prevail, but long tobacco barns and white-colored sugar mills show the importance of the two commercial crops, tobacco and sugar.

In the eastern extension of Java south of the shallow depression of the Strait of Madura the volcanoes are nearer each other and almost join. The basin of Malang recalls the picture of the western intermountain plains with almost every inch brought under cultivation; while the low slope of the Kawi-Ardjuno in the west and the Tengger-Smeru (Java's highest mountain, 12,200 feet) are covered with estate gardens of rubber and coffee. The dual structure of the Lamongan-Yang and the huge caldera of the Idjen complete this description of Java's central volcanic backbone as the narrow strait Bali separates the island from its eastern neighbor Bali.

Southern Coastal Zone. The fourth and last physiographic division of Java

resembles geologically, as well as in many relief features, the hilly zone in the north. Here sedimentary rocks likewise come to the surface; marl, sandstone, limestone, and breccia. Three sub-regions can be recognized.

(1) The western part has principally a high plateau character. The general slope is southward and the break toward the ocean is rather abrupt leaving little or no space for a coastal plain. Rivers have deeply dissected the plateau and in many cases rough mountain topography results. Dense forests in which the wild banteng is roaming round still prevail, but in late years man has also invaded this less hospitable part of the island. Sawahs follow the river valleys, crop-fields cover many of the deforested slopes, and rubber forests and teagardens indicate the extension of estate agriculture beyond the volcanic chain. In spite of all the economic activity, density of population is still low.

(2) Central Java reveals a break in this zone of mountains and hills. An alluvial coastal plain, densely populated, entirely cultivated, and protected by a row of dunes against the large waves of the blue Indian Ocean borders the central chain. Protected by the hills of the island Kambangan a formerly deeply invading gulf is already in an advanced stage of silting up. The southern part, the so-called Children Sea (Segara Anakan) is not much more than a tidal swamp where fishing villages built on piles like stilts rise above the water at high tide and have a mud base as the sea retreats at low tide.

(3) In the residencies Jogjakarta the hills of limestone and breccia again reappear and continue up to Java, southeast point, forming the third subdivision of the southern zone. Lower than in the west, they form a generally inhospitable mountain region breaking off steeply against the sea. The many natural bays would be helpful for trade if the hinterland were more productive, but although the natives have found spots for their agricultures and the estates extend over certain sections, the economic value is slight. No harbor of any significance has developed. In Jogjakarta tropical karst-erosion has led to typical so-called cockpit topography, thousands of round white limestone hills separated by sink-hole depressions in which the terra rossa has been used for plots of corn and gardens of bananas, form a natural labyrinth, the Goenoeng Sewa or thousand hills.

CLIMATE

Java, as was indicated in the general description of the Malaysian climate, is dominated by monsoons. Eastern winds from the Australian continent blowing towards the Asiatic low prevail from May to October; western winds from Asia towards the Australian low from November till April. For a good understanding of land utilization and especially of the contrast between West and East Java, it is worth while to go more into detail.

The major factors of Java's climate are: (1) The west monsoon carries a great deal of moisture, a result of its long distance over a warm ocean, and the high moisture content which causes heavy convectional rains over the warm lowlands and very heavy orographic rain where forced to rise over mountains;

(2) The east monsoon which is a dry continental wind of which the moisture content increases on its way westwards by picking up moisture, while its speed decreases. Wherever the east monsoon is strong convectional rains are absent but orographic precipitation may result from a forced rise over high mountains;

(3) On the leeward side of the central mountain wall of West Java convectional rain falls even during the

dry season but only on a rather narrow zone, and farther away from the mountain protection the dry winds prevail again;

(4) Because the rainy season is brought in from the west and the dry season from the east, East Java gets its rains later, while they last for a shorter period than West Java;

(5) On the northern plain the winds shift abruptly from east to west and vice versa but on the south coast they veer slowly through the south, causing onshore winds during the transitional period and local showers along the coast.

recorded for a station on the north slope of the central Javanese mountains, namely Jasaredja with 33 feet of rain a year.

Rainfall Types. Doctor Boerema of the Royal Observatory in Batavia has recognized 66 rainfall types in Java. Seven of these are given here for a better picture of rainfall conditions. Charts I and II give the typical conditions on the northern coastal plain. They are similar, except for the fact that the western type has more rain and a shorter dry season. Rainfall comes generally in heavy convectional showers

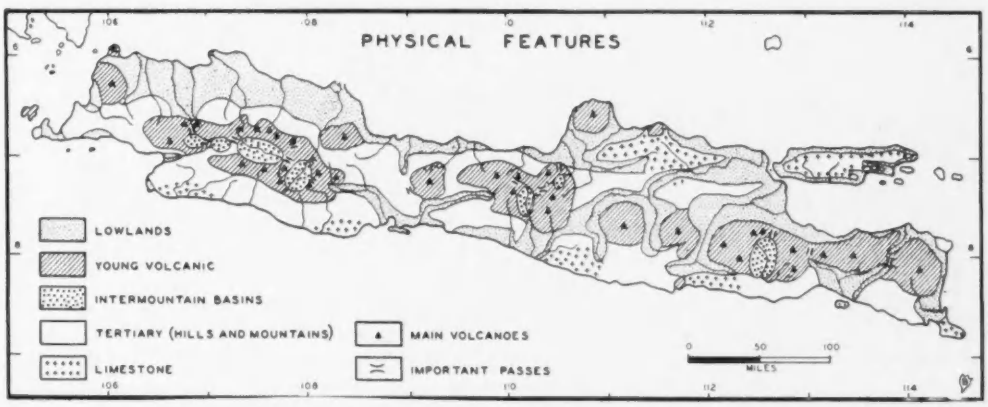

FIGURE 2.—Although the general impression may be one of complexity, nevertheless the zonal arrangements described in the article can be easily recognized. The contrast between the lowlands along the north coast and the mountains along the Indian Ocean stands out clearly.

General Remarks on Rainfall (See Figure 3). Rainfall is generally heavy over the island. Only in the extreme northeast corner (Besuki) is it below 40 inches. The rainfall zone of 40–60 inches is limited to some coastal sections in East Java and the region east of Batavia. Most of the lowlands have accordingly more than 60 inches of rain and in places up to 100 inches.

The mountains are marked by heavy precipitation. Recognizable on the map because of high rainfall is the contrast between the double range system of West Java, the single chain of Central Java, and the isolated volcanoes in the east. The highest average amount is

around the middle of the day, while the mornings and evenings are clear. Real cloudy days are rare, even during the rainy season.

Charts III and IV interpret mountain rainfall. The first one has no real dry season; the rainfall is less during the east monsoon regime but far from absent. A slight double maximum is recognizable under influence of near equatorial location well protected by mountains against too much monsoon interference. Chart IV is representative of the section with very high rainfall on the north slopes of the mountains in Central Java. The west monsoon here strikes the continuous chain at a

slight angle and the orographic factor increases considerably the severity of convectional showers. In contrast with West Java a decided dry season occurs, because the east monsoon is still powerful and in some cases even a föhn affect increases the drought.

The other three charts show the rainfall distribution along or near the south coast. In Chart V the orographic influence of the high upland along the Wynkoops Bay is responsible for a very wet rainy season, which comes earlier than in Chart IV because of its more eastern location. Chart VI is very different from the others. The rainfall is evenly distributed throughout the year, with a short pronounced maximum in the later part of the year. The winds are then from a southern direction causing onshore winds and orographic precipitation. Finally Chart VII pictures a southeast facing volcanic slope, where the generally dry east monsoon is forced to rise sufficiently to cause orographic rains during the dry season.

AGRICULTURE

Java is an agricultural Eldorado. The unusually high percentage of cropland is not only able to feed a teeming population of over 40 million, but to provide as well a combined export of products of native and estate agriculture amounting in 1929 to a value of almost one-quarter of a billion dollars. This has decreased during the world depression to only 60 million in 1933, but it may be expected the value will rise again for surely these conditions are abnormal and only temporary. Interesting is the comparison with Cuba, another tropical island of a high value of exports. The difference is that the population of Cuba, around four million, depends entirely on the sugar and tobacco industry and faces starvation when those decline, while the export of Java, only slightly larger in size, is of a much greater variety and the 40 million natives are only comparatively slightly involved in the present great slump in world trade because the

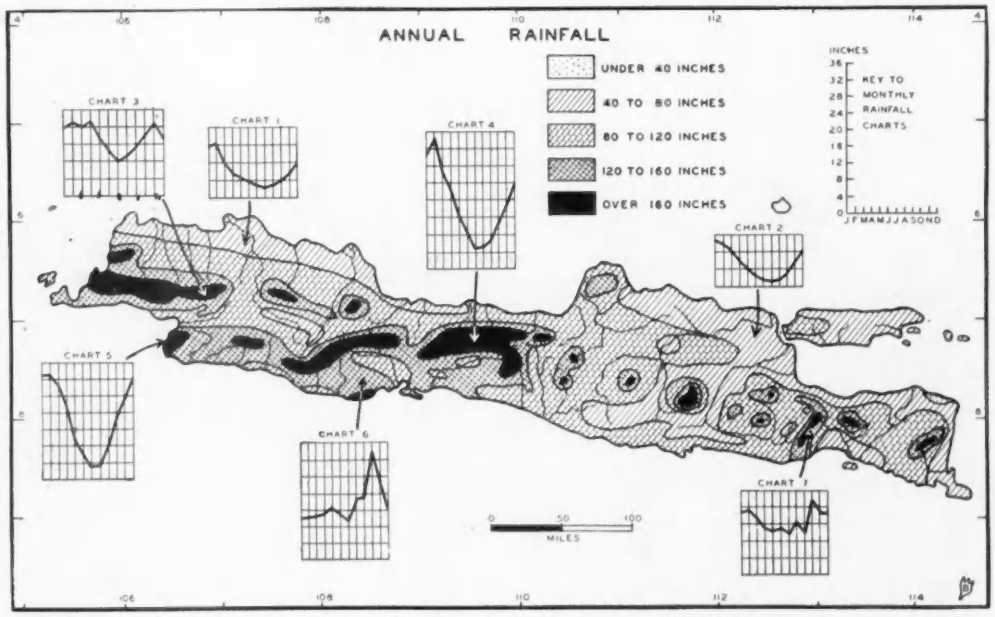

FIGURE 3.—Java is no exception to the general rule that heavy rainfall characterizes equatorial regions of the world. The different types of rainfall distribution, of which the most typical are shown on the map, explain the variety of landscapes, and the diversity of agricultural industry, which characterize the island.

FIGURE 4.—The political divisions of Java have been recently revised. Because present statistics refer to new divisions it seems worth while to point them out on the map in order that they may replace the earlier established names of political units.

island is self-sufficient in its food supply. Table I shows the variety of export products, and also the share in them of estate agriculture. Nevertheless the discussion of Java's agriculture begins with its most important element, the native food production, because on that element depends the welfare of the population.

TABLE I

AGRICULTURAL EXPORT—1933
(Considering only those with weights above 10,000 tons)

Crop	*Weight (in 1,000 tons)*	*Value (in million guilders)*	*Percentage of Export Derived from Estate Production*
Peanuts	16	2.5	0
Fibre	28	2.5	100
Rubber	75	11.5	100
Tapioca	170	9.0	13
Copra	80	4.4	4
Kapok	55	8.3	10
Coffee	12	5.0	100
Corn	78	2.2	0
Sugar	1374	62.1	99
Tobacco	40	11.1	40
Tea	59	21.7	79

Native Agriculture. Agriculture is the basis of the economic life of Java and the Javanese is essentially a farmer. He lives in small villages and his economic interest is concentrated on his cropfield, which he generally owns individually or as part of the village communal system. It has been the duty of the government to protect that ownership against attempts of capitalistic organizations to buy the land and use it for commercial crops. Two kinds of agriculture can be directly recognized, the irrigated type—the paddyfields,—and the non-irrigated type; both will be subsequently treated, but first some general remarks will be made.

Java belongs with the most completely cultivated regions of the world. Figure 5 gives the percentage under crop cultivation; the figures include plantation crops, but even without those the percentages are only slightly lower; for the figure for Java as a whole drops from 60.1% to 58.4%. A study of the map shows that the southwest (Bantam, Buitenzorg, Priangan) has the lowest percentage, partly as the result of unfavorable relief, namely the mountains along the south coast, but also partly because of the rather recent introduction of more intensive farming which infiltrated only slowly from the central part of Java, the ancient nucleus of economic and cultural development. For the same reason is the percentage low for the extreme southeast (Besuki). Central Java has the highest percentages of cultivated land; Kedu, Jogjakarta, and Surakarta have even about 80% of the total area under crops. The island Madura has also a percentage above 80%, but is not comparable to Central Java because of a much lower agricultural intensity. The figure of 82.6% for Kedu signifies that except for a few high volcanic peaks and the area used

for homes and roads, almost all is cultivated.

With a population of around 42 million—and this number is still increasing regularly—the problem of self-sufficiency is prominent. It can be said that Java under present conditions is self-supporting and that even the formerly considerable imports of rice have disappeared except in bad crop years, made possible through increasing acreage of cropland and through promotion of other crops besides paddy. While rice consumption has not decreased (it is above 200 pounds per capita), use of cultivation will mean lower yields because only inferior land is now still available, while higher yields of crop over the island are also difficult to obtain. It is hoped that the population automatically will reach eventually a status quo based on maximum food production and will not exceed the agricultural possibilities.

Paddy (*irrigated rice*). Rice is Java's primary crop (see Figure 6). It may have lost part of its glory and the planted acreage is at present only 40% of the total planted surface, while in 1916 it was 51%, but it still ranks first in the native's appreciation. No

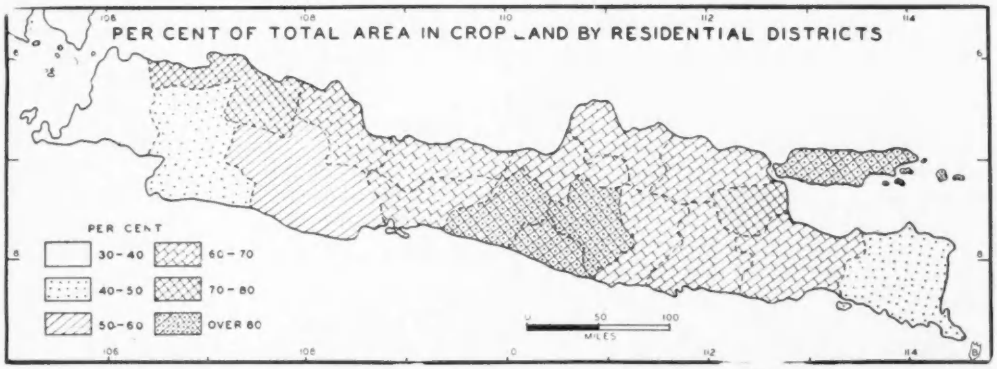

FIGURE 5.—Java is one of the most densely cultivated regions of the world. As the map shows, more than 60% of the total area of Java is under crop, while in three political divisions the percentage is above 80%, an extraordinarily high figure especially under equatorial conditions.

other foodcrops has increased considerably and the Javanese in spite of rapid increase in numbers are now better fed than in former times when the population figure was very much smaller. Using rice as a food unit, composition of the average Javanese diet was in percentages in 1927: rice 41.7%, corn 24.7%, cassava 20.5%, soy beans 5%, others 7.4%, while the drop in percentage of rice in the diet was 10% between 1915 and 1927. It is an open question whether self-sufficiency can continue with continued population increase. Growth of population was 20% between 1922–32, while increase of paddy acreage was 5% and dry cropfields 15%. More land brought under other food crop requires so much work, but also no other crop has so much influenced his life and customs. While all paddy is irrigated, the type of irrigation differs. One-third of the rice acreage is really technically controlled so far as irrigation is concerned. A minor part of the rest has a kind of casual type of irrigation, while the greater part depends entirely on rain. All paddy is started first for a period of forty to fifty days on nursery beds, and then is transplanted to the sawahs, where it ripens in about four and a half months. On the technically irrigated sawahs, especially those located near mountains, which receive rain during the east monsoon season, a second crop

of rice can be raised wherever the fertility of the soil permits; otherwise a secondary crop is planted. The sawahs based on rain alone generally lie fallow until the next rainy season.

Figure 6 on the distribution of rice shows a clear concentration of the sawahs on the lowlands and in the intermontane basins. Rice in those sections is in places the only crop, leaving the native villages with their fruit trees as little islands amid the water-covered sawahs. The highest percentage of rice occupancy is found in a district of Surabaja with 131% while the highest percentage of sawahs occupancy (eliminating the non-rice acreage) is 195%, reached in a district of Kedu; both cases of course are the result of a second or even perhaps a third crop of rice.

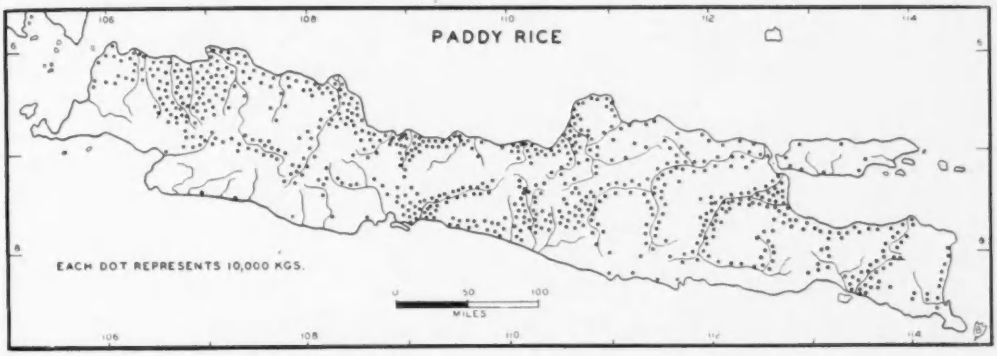

FIGURE 6.—Rice is Java's most important crop. A comparison with Figure 2 shows the relation between rice production and physiography. The coast lowlands, the river valleys, and the intermontane basins stand out clearly as areas of production.

Table II gives the percentage of sawahi in relation to the total planted acreage for the three major divisions of Java.

TABLE II

Percentages	*West Java*	*Central Java*	*East Java*
Below 25%	3.4	7.2	15.1
25–35%	10.4	6.5	19.8
35–45%	11.1	18.9	14.8
45–55%	19.1	17.9	15.3
55–70%	22.4	25.4	24.3
Above 70%	33.6	24.1	10.7

The greater relative importance of paddy clearly stands out in West Java as compared with East Java, while Central Java forms a transition.

The same relation is obtained from a study of the absolute percentages. In West Java 68% of the total planted area is in rice while the figures for Central and East Java are respectively 45% and 28%.

Several factors are involved in the explanation of this contrast. Climate is important; the greater amount of rain in the west and the longer rainy season favor rice there. A second factor is the great extensions of area with poor, leached soils (derived from rocks of older geologic age) in East Java, where the rugged relief is also less suitable for irrigation. Finally rice meets maize in the eastern part as its rival and the increasing importance of the corn crop has been a strong factor in limiting the increase of rice fields, in some cases even causing a real decrease in rice acreage.

NON-IRRIGATED (DRY) CROPS

Corn (*maize*) ranks first among the dry crops, as has been indicated in the food chart on page 34. In 1933 5½ million acres were planted to corn. The map of corn production shows clearly the contrast between the western and eastern part of the island, a response to climate. In the west, where rice dominates, corn is not appreciated as food. Fields of corn can be found on the mountain slopes, usually above the tem-

perature limit of rice—it is even possible to recognize a real corn belt between 5,000 and 6,000 feet,—or is grown occasionally as a secondary crop on the sawahi, but it remains of minor significance. In East Java where large sections are not suitable for irrigation, corn becomes the first food crop. Here one-half of the planted area is in corn, while the figure for West Java is only one-fiftieth, and for Central Java, the zone of transition, one-quarter.

On the island Madura, with its tertiary hills, and in the residency Pasuruan, with its lack of lowland, corn reaches its peak of dominance with three-fourths of the planted area occupied by it. As with rice, the one crop system prevails, but occasionally two and even three crops a year are found, in the last case one of them growing during the dry season must be irrigated. The highest figure reached for occupancy is 150% in a district in Besuki. Corn is also used frequently as a fodder crop and generally cattle and corn go together. Because the natives use cattle manure to fertilize their little tobacco plots, there is an interesting co-relation between corn and tobacco.

Cassava. The next dry crop in importance, cassava, the source of tapioca, covers only one-third of the area devoted to corn. Its food value, as indicated on Table I nearly approaches that of corn and even surpasses it in years of low corn yield. Its value as a native food is principally to supplement rice or corn, when they are scarce, but it is used also as a delicacy, giving a change in the otherwise monotonous diet. Cassava has the advantage that its harvest can be postponed for a considerable period, without much harm to the yield, until there is a demand for it. Its distribution approximates that of corn, but does not afford such contrast between west and east.

Padigogo (non-irrigated rice). Padigogo, planted to one million acres, comes third in the list of dry crops. It differs from the paddy rice only because of difference in cultivation. The rice is seeded directly on the field. The yield is considerably lower, partly explained by the fact that the better soils are prepared for irrigation. Padigogo grows during the rainy season. It finds its chief concentration in the mountain districts of West Java, where in Bantam it even covers 30% of the cultivated area.

Other Dry Crops. Among the many other dry crops, sweet potatoes (400,000 acres), peanuts (500,000 acres), and soy beans (700,000 acres) are noteworthy. Sweet potatoes have their value as additional food. Their distribution is rather irregular without showing much response to climatic differences. Madura has the highest percentage (10% of the cultivated area) but also Priangan is prominent in this production. Peanuts are used for food as well as for oil purposes; with their high food value they are a valuable addition to the Java food supply and the peanut vendor is almost as popular there as in Cuba. Like that of the sweet potatoes, the distribution of peanuts shows no definite geographic limitations. The soy bean is used on the sawahs as secondary crop, it is used for the making of soya, but also as food for cattle (soy cake).

Fruits and Vegetables. Fruits are most conspicuous to the traveller in Java. The little native homes are hidden under the foliage of fruit trees and the coconut palm is, except on high elevation, always present. Along the road children try to sell fruit, brilliantly colored, to the passers by, and no native meal is complete without some fruit dessert. Nevertheless fruit raising is, in

general, not a commercial enterprise and most of the food is consumed on the place where it is grown. Two kinds of fruit stand out in importance: the coconut, as a source of cooking oil, and the various types of banana, which are used in large quantities. Some of the other well-known tropical fruits are the pineapple (Ananassa sitarra), the breadfruit (Artocarpus incisa), the papaya (Carica papaya), the durian (Durio zibethinus), the mangistan (Garcinio mangostana), the duku (Lansium domesticum), the mangu (Mangifera indica), the rambutan (Niphelium lappaceim) and various kinds of citrus fruit.

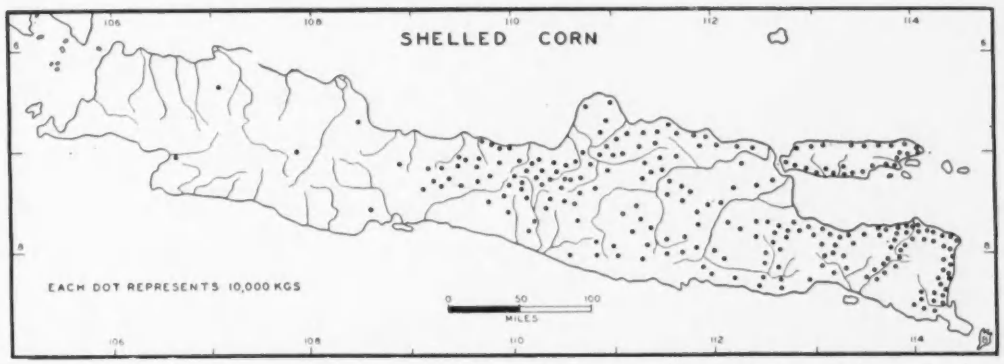

FIGURE 7.—Corn becomes of increasing value as a foodcrop. The distribution of the production reflects the climatic difference between West and East Java, and also the difference in geologic structure.

Vegetables, used in vegetable sauce with the rice, are also home grown, but one finds on the higher slopes and on some of the plateaus regular truck farming of European vegetables, which are sold on the city markets, chiefly for the white man's use.

NATIVE EXPORT CROPS

The surpluses of some food crops are exported, notably peanuts, corn, cassava, copra, and even some high quality rice. The export of tea and tobacco, both produced by native farmers, will be treated under the estate agriculture of those crops. One commercial crop almost entirely controlled by production on native garden plots needs special mention, namely kapok. The export takes place mainly in the form of fibre, but also as seed, seed oil, and seed cake. Though originating in tropical America, the kapok tree found in Java its foremost economic development. The trees are found round the homes and along the roads. Chinese merchants buy the kapok from the natives. After cleaning the kapok is packed in bales, while the seeds have value for their oil content. A kapok cleaning place in the open air looks like a winter landscape, the result of white flecks of kapok scattered about like snow.

LIVESTOCK

Except for a quarter of a million horses, all of small type, and a million goats, as well as the ubiquitous chicken, buffalo and cattle represent the domestic animal stock; both are an essential part of the land utilization because their value is chiefly as work and draught animals.

Figure 8 indicates a definite arrangement in the distribution of buffalo and cattle. The buffalo, of which there are 2 1/5 million, are rather well distributed over the island except that they are practically absent in the extreme east and on Madura. The cattle (4 million) show a concentration in the east; their impor-

tance declines rapidly westward, until in West Java they are no longer of economic significance.

The numerical predominance of cattle over buffaloes is only of recent date. In 1841 an estimate gave 1½ million buffalo and only ½ million cattle. Nevertheless the cattle are not newcomers, which is proven by the fact that a wild form, the Banteng, is still found in the dense forest of southern West Java.

The buffalo is the work animal par excellence for work on heavy soils of the irrigated rice fields. Its hoof fits the buffalo specially for that purpose. But the buffalo has also decided drawbacks, if compared with the native cattle. It has less resistance against illness and heat, it is painfully slow, and rather difficult to feed because it needs grazing—a difficult factor in a cropland country, while finally the flesh is of a much lower quality.

The rapid increase of the number of cattle was made possible chiefly through the increased production of corn. Cattle can be stall fed, and the grazing area, reserved for the buffalo, can be used for cropland the moment the shift from buffalo to cattle is made. In contrast to the buffalo the cattle are more valuable on dry fields which explains the concentration in East Java. In Madura where the absence of wet rice fields is marked and corn is the chief crop, cattle have gained their greatest importance. This process of replacing buffalo by cattle is still going on but the buffalo will keep its place on the clay soils of West Java. There it is a familiar sight to see small boys looking after herds of these big animals grazing along the road, while others, submerged in the river except for their noses, enjoy the refreshing water as well as the mud coat which protects them after their bath against the attack of mosquitoes.

FORESTRY

Equatorial forests, varying in botanic composition according to climate and soils, once covered Java completely, but only 17% is left of which 1/3 is teak (Tectona grandis, Javanese djati). The so-called wild forests find their major extension along the south coasts of West and East Java, where the topography is mountainous, and on the higher slopes of the central volcanic mountain chain. The economic value is slight for the development of estate agriculture has caused a great decrease in area.

Very valuable are the teak forests (2 million acres) which are almost entirely under control of the forest service of the government. It is a typical monsoon forest, the trees lose their leaves during the dry season. The location of these forests correlates in general with the limestone hills of North Java, especially in the eastern part (residencies Japararembang, Bodjonegoro, Madiun, and Semarang). In economically ordinary years the sale of teak provides a good profit to the government.

FISHING

A description of Javanese agriculture would not be complete without a reference to fish, which is an important part of the diet. Since fish, except in a dried form, are not a product which can be transported easily over long distances in a hot climate, without refrigeration, it might be expected that fish are only valuable as food along the coasts, and the rivers, where they can be caught. But that is not the case. A regular fish cultivation takes place all over Java, but especially in the western part, in the many small fresh water ponds, which are found in the small garden plots round the homes. Carp (Cyprinus carpio) is

most popular for the purpose. Also the sawahs, reflooded after the rice harvest, are in some places used as fish ponds and fish in that case become a secondary "crop." Much larger in area are the coastal salt and brackish water fish ponds, estimated to cover about 130,000 acres, of which 4/5 are along the coast of Surabaya. Here the "seedfish" are "planted" twice a year, and the fish grows up naturally in the large ponds, while the water is renewed several times. The full grown fish is then sold in the nearby city market.

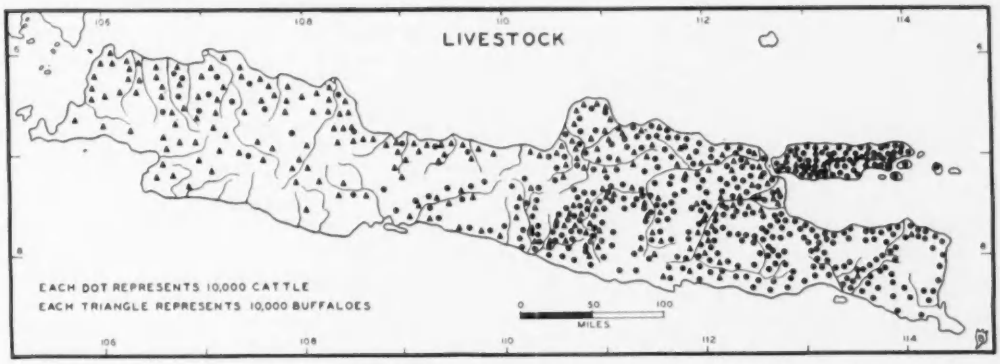

FIGURE 8.—Without help of water buffalo and native cattle, preparation of the cropfields would be impossible, but the slow-moving draught animals are a despair to Javanese motorists who would make haste.

PLANTATION, OR ESTATE, AGRICULTURE

Estate agriculture, with a planted area of 1½ million acres, features prominently in the land utilization of Java. This importance nevertheless does not mean that all those acres are taken away from the nation's food production. Most of the plantations are located in formerly unproductive lands. Such is the case for most of the tea, coffee, and rubber plantations, which are given in long lease to capitalistic companies for the purpose of raising those commercial crops. Only for sugar and tobacco, which both need the same climatic and soil conditions which also favor rice production, is a limited acreage rented in short lease from the native for one crop only and then returned. Large private holdings which are a relic of a former colonial system are still found in the residencies Buitenzorg and Batavia but are gradually bought back by the government and given back to the population.

Estate, or plantation, agriculture is so controlled and carefully regulated by government laws that no abuse of native rights can occur and its influence on the economic development of the island has been decidedly a favorable one. Not only does it bring people to formerly uninhabited regions and give work to thousands of natives but it is responsible for much of the excellent system of transportation and the general economic and cultural improvement of the island results from the taxes upon the plantation industry and the land it uses.

The system of estate agriculture was severely tested during the present economic depression. The value of the export of plantation crops which in 1929 obtained a peak of almost half a billion guilders (200 million dollars) dropped in 1933 to less than one-fourth of that amount while 1934 was probably even worse. The breakdown of the sugar industry was mainly responsible for this sharp decrease, but also other branches of estate agriculture suffered heavily. The results were obvious. The white

population employed on the estates received lower wages, while many were discharged; transportation and trade dropped accordingly and the government income decreased so much (the tax on companies brought in 1928, 60 million guilders, in 1934, only 7 million) that severe economies had to be made. Nevertheless the native population if not directly in employ of the estates, was not greatly involved. Of course, it felt the depression but agricultural self-sufficiency saved it from fatal complications. The great estate crops have never become an economic danger; they are an asset, not a burden.

Sugar. Sugar is not entirely an estate crop in the real sense of the word. The sugar company only owns the factory and rents part of the surrounding fields—chiefly rice fields—for the raising of its crop. No more than one-third of that area may be rented, while after the harvest the land is returned to the native to grow rice or a dry crop; in that way no ratoon crop is obtained, in contrast to the type of production in Cuba where the ratoon is important. The government is very careful not to increase the acreage under sugar to such an extent that the rice crop would suffer considerably and Java's self-sufficiency be endangered.

In 1931 the peak in production was reached with a planted acreage of half a million. Because of the limit in areal expansion the Java sugar producers were forced to go in for high yield in cane as well as in sugar content, if they wanted to become an important factor in the world sugar market. They accomplished this by the application of the results of scientific research. The sugar experimental station at Pasuruan became widely known and Java sugar cane types were introduced in various sugar cane producing countries.

Starting with nurseries located on the uplands, through a carefully worked out process of irrigation and fertilizing, up to the grinding of the cane and the crystallization of the sugar, the Java sugar industry could boast an efficiency rivalled perhaps in Hawaii, but nowhere surpassed.

In 1930 the sugar production reached almost 30 million quintals, 16% of the world cane sugar production, second after Cuba in rank of export.

Figure 10 shows the concentration of production in the alluvial lowlands of East and Central Java, a zone extending in the residency Cheribon slightly into West Java. A similar map made in 1930 would have shown that concentration even more clearly, but since then—as will be discussed later—production declined sharply and formerly important sugar producing sections (Banjumas and Kedu) have been temporarily abandoned.

To grow well sugar cane needs an average temperature of 75°–77° F., which makes it a tropical lowland crop; plenty of water through rain or irrigation; and dry weather during the last three months before the harvest. This last factor eliminates from production the lowlands of West Java where the dry season is too short and the amount of sunshine during that period not sufficient. An interesting study on the relation of climate to sugar production has been made by Dr. Werner Schulz (see list of literature).

The Java sugar industry, which by its efficiency seemed to have solved all economic difficulties, was deeply involved in the world depression and low sugar prices. The reasons for the depression are found in an increase of the world sugar-production from 20 million tons in 1913 to 31 million tons in 1930, a result of the successful attempt by beet sugar producers to regain their former position, in regard to cane sugar, lost

during the World War. At the same time the world consumption amounted only to 26½ million tons. In order to balance production and consumption Cuba, Java, and many European beet sugar producers signed in 1931 the so-called Chadbourne agreement limiting their production. This effort failed because the contractors did not control the world sugar production sufficiently. A 50% reduction on the Chadbourne lands was almost made negligible through a 25% increase of production by the outsiders, who finally in 1934–35 actually produced 20 million tons of a total production of 26 million tons. Furthermore Java, which has to sell its crop for the greater part in the Far East faces at present a sugar surplus in Japan—which was formerly a good customer—a surplus in the Philippines (above the allotment into the United States), increased production in India, and high import duties on sugar in China. Java's very high sugar surplus caused a sharp drop in production. In 1933 only 1.3 million tons of sugar were produced and only 97 mills out of a former total of 179 were running.

Production in 1934 was 0.65 million tons and the estimated production for 1935 only half a million tons. The dot map represents conditions of the year 1932, low in comparison to 1930, but much higher than the present situation. Government methods for rationalization of the sugar industry may lead to a way out of this economic morass, but it is not probable that Java will ever regain its former rank in sugar production.

Tobacco. Tobacco companies, like the sugar mills, rent the land from the owners and after the crop, give it back for rice production. Most of the estates are located in the native states Jogjakarta and Surakarta as well as in the residency Besuki, in East Java. Tobacco, like sugar, involves complicated procedure of production, and the methods used are the result of many years of experience and experimentation. The product, especially that from the native states, is of high quality and the Java wrapper leaf under the trade mark De Vorstenlanden, meaning the native states, ranks next to that of Sumatra on the world market. In 1933, 37 estates had 66,000 acres planted with tobacco with a production of 25 million Kg. Very much higher is the acreage of native tobacco (300,000 acres); its concentration is similar to that of the estate crop, but small tobacco plots are also found throughout the island. The quality is much lower and a great deal is consumed on the island itself as cigarette tobacco. The export value of the na-

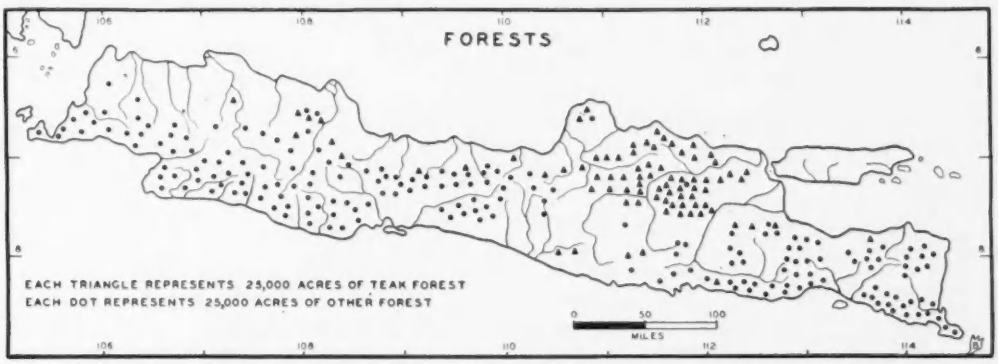
FORESTS
EACH TRIANGLE REPRESENTS 25,000 ACRES OF TEAK FOREST
EACH DOT REPRESENTS 25,000 ACRES OF OTHER FOREST
0 50 100
MILES

FIGURE 9.—Forests have lost a great deal of their former extent and are almost limited to the southern mountain region. The northern limestone hills offer ideal growing conditions for the valuable "teak."

tive tobacco is only half of that of the plantation product, although in quantity it is twice as high.

Tea. As the map distribution shows, tea is almost entirely limited to West Java, especially to the residencies Buitenzorg and Priangan. The main reason for this is that the West Java mountain climate, with only a short drier (and not dry) season is admirably suitable to the raising of tea, while the climate in East Java is much better suited to coffee. It is interesting to note that the few tea estates in Central and East Java are located where the east monsoon is forced to rise against the southeast slope of the mountains. A typical rainfall distribution for one of the best estates gives the following figures (in inches):

January	14	July	2½
February	13	August	2½
March	13	September	4
April	11	October	8
May	7	November	11
June	4	December	31

But many other factors enter into tea cultivation. Elevation is important, although it varies between 1,000 and 6,000 feet. In general it can be stated that the low estates have to go in for quantity, the high estates for quality. The best tea is raised at almost the highest elevation, where night frosts enter as a limiting factor. Then the location of the estates show the importance of drainage for water as well as for air; tea is principally a hill or mountain crop, while the valley bottoms or basins were already in cultivation of rice before the tea estates were established. Too much wind and too high cloudiness are other limiting factors. The best soils for tea in Java are the young volcanic soils, while also some soils rich in humus—where the forest has just been cleared—give good results. But tea demands much of the soil and fertilization—chemical as well as by way of manuring plants—is intensively practised.

Java had in 1933, 293 tea estates with a planted area of more than 200,000 acres and a production of about 50 million Kg. Each estate has its quality ranking which it either seeks to improve upon or to live up to. It has already been stated that estates in general bring life into formerly isolated spots. Labor has to be brought to it, roads are built, and a tea estate with its well-planted gardens, its clean factory, luxurious manager's home, and its colony of white supervisors and native workers is often like a small unit of production lost amid the great forests which still cover the mountain of Buitenzorg and Priangan. In the neighborhood of the tea estates the natives have taken up also the raising of tea, which they sell to the estate factory while in some cases factories are built depending entirely on the native crop. In that way about 20% of the total export of around 60 million Kg. comes from those natives' gardens and has helped considerably to raise the standard of life in those sections.

Coffee. The *Coffea robusta* solved finally Java's coffee troubles after the attack of diseases, notably the coffee blight. Very little is left of the original Java coffee (*Coffea arabica*) which once made Java famous as the world's great coffee producer; nor of the Liberia coffee which was introduced in an effort to find a successor for the ruined Java coffee. Concentration of coffee production is found on the slopes of the volcanoes of East Java. Here on an elevation from almost sea level to 3,000 feet coffee finds its climatic optimum, which differs from that of tea principally by the fact that coffee needs a definite dry season during the blossom period in order to avoid the damaging of the flowers by heavy showers. A typical rainfall distribution for a coffee estate is the following (in inches):

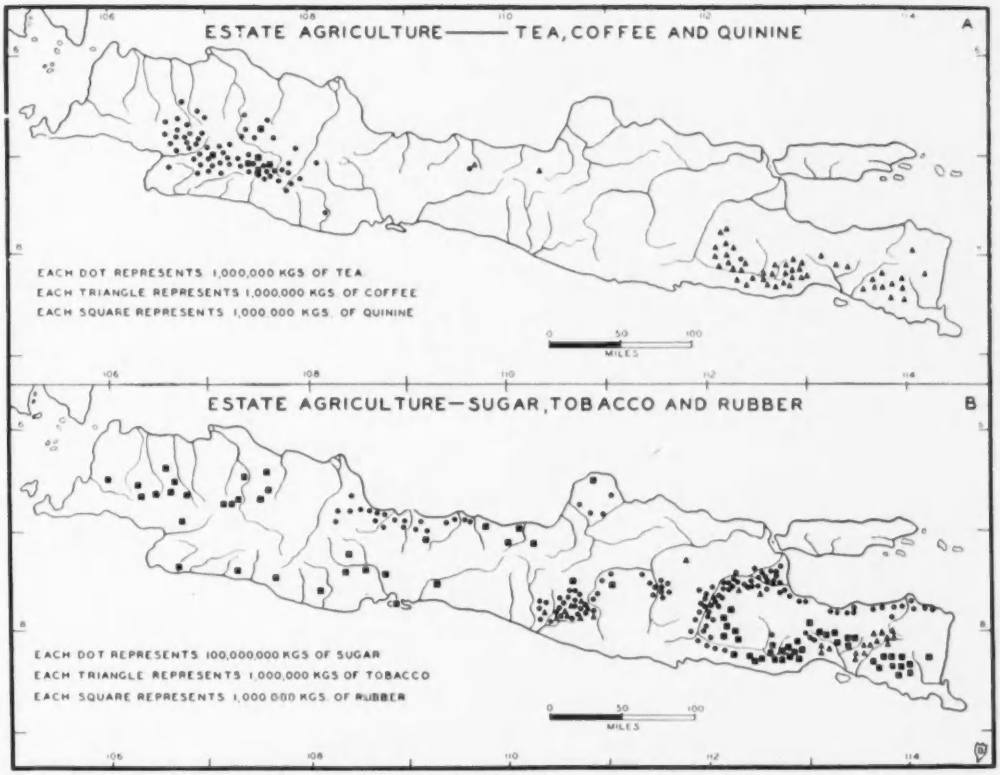
ESTATE AGRICULTURE——TEA, COFFEE AND QUININE
A
EACH DOT REPRESENTS 1,000,000 KGS. OF TEA
EACH TRIANGLE REPRESENTS 1,000,000 KGS. OF COFFEE
EACH SQUARE REPRESENTS 1,000,000 KGS. OF QUININE
0 50 100
MILES
ESTATE AGRICULTURE—SUGAR, TOBACCO AND RUBBER
B
EACH DOT REPRESENTS 100,000,000 KGS OF SUGAR
EACH TRIANGLE REPRESENTS 1,000,000 KGS OF TOBACCO
EACH SQUARE REPRESENTS 1,000,000 KGS. OF RUBBER
0 50 100
MILES

FIGURE 10.—Estate crops are not evenly distributed over the island. Their yield and quality are ultimately controlled by geographical factors of climate, relief, soil, and elevation. A comparison with maps of rainfall and of physical features is desirable when reading the explanation of their distribution.

January	14	July	2
February	12	August	3
March	10½	September	2
April	6	October	6
May	4	November	9
June	3	December	14

Quite a number of the 318 coffee estates favor the planting of coffee together with other crops, notably rubber. Coffee is then often a catch crop for rubber, yielding a profit, while the rubber trees cannot yet be tapped. A permanent combination also is possible by leaving more space between the hevea trees. In that way the risk of a loss is considerably less.

Coffee production reached in 1933 an amount of 50 million Kg., an increase of almost 50% since 1922.

Rubber. In contrast to Sumatra, rubber in Java is exclusively an estate product; 580 estates with a planted area of 570,000 acres, of which 460,000 in production yielded in 1933 75 million Kg. of rubber, one-quarter of the total rubber production of the Netherlands East Indies. The map of distribution gives two major zones, one in West and one in East Java while Central Java is less important.

In West Java the productive area is chiefly located on the lower mountain slopes (rubber does not grow above 2,000 feet). The north side of the northern volcanic chain, southwest Buitenzorg, and the extreme east of Priangan are the chief centers. In East Java rubber coincides rather closely with the distribution of coffee on the lower volcanic slopes, where, as has been stated, mixed cultivation is possible in many cases.

Rubber is not particular about soils. It demands a wet climate but can stand

well a not too long dry period. Its introduction into Java came late and the rubber companies did not have very much choice left, as most of the available estate area was already taken up for other crops. The economic side of rubber has been taken up in the preceding installment. It is worth while mentioning that the Government itself owns 12 rubber estates with 32,000 acres planted. While the government has for many crops experimental estates to encourage production, here the sale of the Government production goes beyond the experimental stage.

Quinine, the abstract from the bark of the cinchona tree, is quite a technical crop to raise. The best conditions for the growth of the tree are found on a 5,000-foot high plateau south of Bandung, where a Government estate contains more than half of the planted acreage. Two types of cinchona trees are commercially raised, the Ledgeriana, which is the best producer of quinine and the Succirubra which is also used for pharmaceutical purposes. The cinchona tree grows between 3,000 and 7,000 feet but most of the estates are found on the higher elevations, while the estates on lower elevations use mixed planting with tea as the main crop. Overproduction caused in 1934 a government restriction plan which granted for 1934 export licenses up to a quinine equivalent of 490,000 Kg. The complete export figures of the Netherlands East Indies are 6.4 million Kg. of bark. Of this production 80% comes from Java, the rest from Sumatra. Besides bark 58,000 Kg. of quinine is exported while the total value of the quinine trade comes up to 6.2 million guilders.

Other Estate Crops. Various other minor crops complete the picture of Java's estate agriculture. Coca, a side product of many estates, especially those of tea; the production varies greatly, in 1933 it was 160,000 Kg. One estate controlled by the government produces about 100,000 Kg. of gutta percha yearly out of the leaves of a palaguiem species. Cassava is only an estate product (12 estates have an acreage of 13,000), but its significance is minor if compared with the so much larger native production. Much more important is fibre, which finds its concentration on the very young volcanic soils of Kediri. A total of 40,000 acres is planted with it; two-fifths is cantala, three-fifths is sisal; the combined export value amounts to 2½ million guilders.

Nutmeg is found on many estates of Central Java. It is rather typical to find a great variety of many crops on the same estate in Central Java. For instance, the author saw in one neighborhood one morning, plots of cacao, coca, nutmeg, castillon, ficus, fibre, dubeb, hevea, Liberia coffee, robusta coffee, coconut, pepper, kapok, tea, quinine, and balsam of Peru; a veritable grocery store growing in a garden.

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A NEW MAP OF THE MANUFACTURING BELT OF NORTH AMERICA

Richard Hartshorne

THE general location of the manufacturing belt in northeastern United States has long been familiar to geographers. J. Russell Smith's "parallelogram" of industry is well known. A more detailed delimitation of the area was made in the notable study of Sten DeGeer.[1] To a certain extent the map of workers in manufacturing in the 1930 Census of the United States shows the location of this belt, but not clearly. For in this map, as well as in that of DeGeer, based on the previous census, wage earners in all manufacturing centers are indicated (on DeGeer's map in all cities of over 10,000 population). But in all populated areas, however non-industrial, there are some kinds of manufacturing to supply local needs. Especially is this so in cities, which must always have bread and bakery plants, newsprinting establishments, and so on through a long list of "ubiquitous" industries. (The relative degree of "ubiquity" versus "concentration" of different industries has been measured statistically in a recent study of the manufacturing belt by economists.[2] Unfortunately for our present purpose of delimiting the area their material is presented only by states.) In any very large city the number of establishments of this sort is very large, even though the city is essentially non-industrial, as, for example, San Francisco or Los Angeles. A map which shows these as manufacturing centers of greater significance than Akron, Ohio, or Reading, Pa., is in a very real sense, misleading. The geographer in particular is concerned with finding the areas where cities are characteristically, or predominantly, industrial, as distinct from those where the cities are characteristically commercial, or of some other type.

In order to eliminate the cities that are essentially non-industrial the writer selected a minimum ratio, 10 per cent of the total population employed as wage earners in manufacturing, as the proportion to be expected in any city, supplying essentially local needs, and not indicating an essentially manufacturing character to the city. This was first applied some years ago to the 1920 Census figures and gave results similar to that of the present map which is based on those of 1930. The map, therefore, portrays the excess number of workers over and above the number normal to non-industrial cities. It seems fair to assume that these are the cities which supply for the most part the needs in manufactured products of other parts of the country, insofar as these are not produced locally.

The excess number of workers for each city, represented by the area of the circles, was obtained by subtracting from the total number of wage earners one-tenth of the population of the city. If the remainder was negative, or less than 500 workers, the city does not appear on the map. Consequently, many large cities which appear as large manufacturing centers on the U. S. Census map, but whose character is dominated by port, railroad, and wholesale func-

[1] Sten DeGeer: "The American Manufacturing Belt," *Geografiska Annaler* 1927, H. 4, pp. 233–259.

[2] Garver, F. B., Boddy, F. M., and Nixon, A. J.: "The Location of Manufactures in the United States, 1899–1929." University of Minnesota Press, 1933.

tions, are omitted on this map. Studies of the writer indicate that this is correct for Minneapolis-St. Paul, which is primarily a railroad center, secondarily a wholesale center and only to a small degree concerned with manufacturing, such as the flour-milling, independent of its local markets. In this group of predominantly commercial cities are included the other major centers of the Western Interior, and practically all of the ocean ports of the country outside of the Boston to Baltimore range. The omission of Birmingham, Ala., and Scranton, Pa., results from the importance of these cities as commercial centers for the surrounding mining districts.

Where suburbs, though politically independent, were known to be geographically continuous they were included in the main center. Likewise, adjacent cities that form a continuous urban area, as at Kansas City, for example, were considered as a unit.

LIMITS OF THE BELT

Just where one will draw the boundaries of the manufacturing area depends on the importance to be attached to small, scattered outlying centers. Clearly the outside limit on the south is approximately the line of the Ohio and Potomac Rivers—more accurately the Ohio River west of Wheeling, W. Va., and the line of the Baltimore and Ohio Railroad east of that point. But is the Ironton-Ashland district at the corner of Ohio, Kentucky, and West Virginia better considered as an outlying district? Dependent on local iron ores this small district of basic iron and steel industry is somewhat independent of, as well as separate from, the main belt. And the three Ohio River bridge cities below Cincinnati, especially the two western ones, Evansville, Ind., and Paducah, Ky., are clearly outside the main area. (The isolated town in south central Indiana is Bedford, the center of stone-cutting for the famous limestone quarries.)

Similarly on the west the Mississippi River, from St. Louis to LaCrosse, Wis., may be taken as the outer limit. The few towns west of the Mississippi are definitely exceptional in character, chiefly meat packing centers, which, not being located at major commercial centers, appear on the map. But if a line is drawn from the western shore of Lake Michigan at Manitowoc, Wis., southwest to include the Rock River cities, thence southeast around the outer satellites of Chicago to Indianapolis and Cincinnati, very few towns of any manufacturing importance will be left between this boundary and the Mississippi River. The lower Ohio and Upper Mississippi consequently appear as strings of bridge cities outside the major manufacturing belt, all of distinctly minor importance with the one striking exception of St. Louis. Both in its importance and in the character of its industrial development St. Louis together with its Illinois suburbs and one satellite city must be classified with such cities within the manufacturing belt as Chicago and Cincinnati, rather than with the more purely commercial cities like Kansas City or Minneapolis-St. Paul outside it. Just where a boundary is to be drawn here is, therefore, not clear.

On the north the boundary is clearer. From Manitowoc, Wis., across Lake Michigan, through central Michigan to Saginaw Bay and the southern end of Lake Huron, thence in Canada across the Ontario Peninsula to the north shore of Lake Ontario, the boundary is essentially the same as that of urban development in general. Beyond this point, the boundary of the *continuous* area of manufacturing crosses Lake Ontario to

Oswego, N. Y., passing immediately north of the string of Mohawk Valley cities to Albany-Troy-Cohoes, thence east along the Fitchburg line of the Boston and Maine Railroad to the Connecticut River Valley, thence a little north to include the southern strip (which includes most of the population) of New Hampshire and the southeastern corner of Maine. Auburn-Lewiston, Maine, marks the northeastern corner of the belt, and Biddeford is the northernmost point on the coast; Portland is excluded as much more largely commercial.

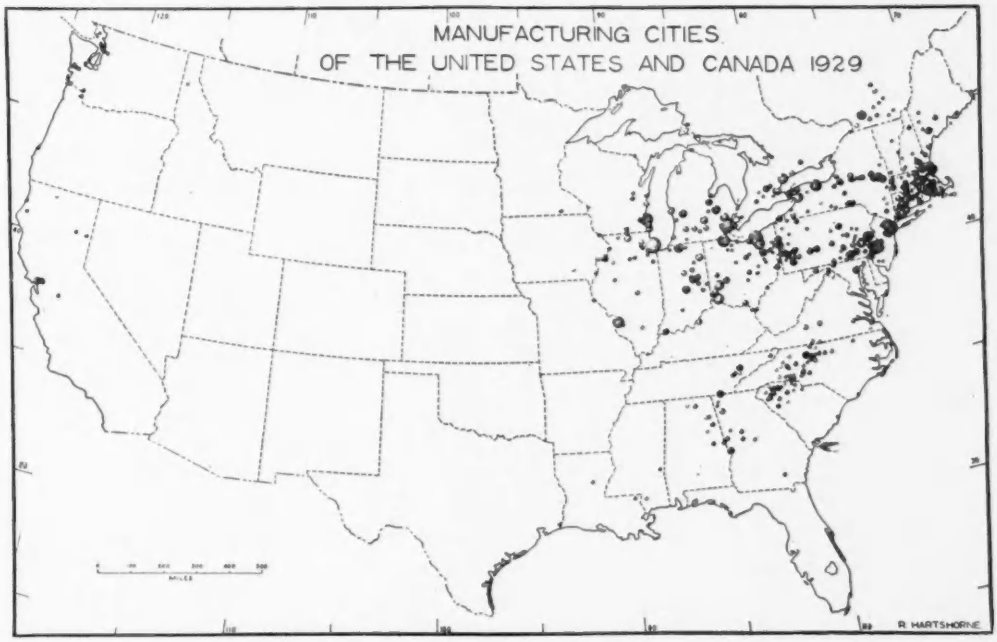

FIGURE 1.—Based on the number of workers in each city employed in manufacturing establishments, less ten percent of the city population. For cities smaller than 10,000 population estimates were made from the totals for the county. Places with less than 500 "surplus" workers are omitted. (Based on the U. S. Census, 1929.)

North of the limit thus described the map shows a number of small centers most of which are chiefly concerned with the primary transformation of local forest or quarry products. The paper pulp centers at Berlin, N. H., and in the St. Maurice River district in Quebec, and even the automobile body factory at Iron Mountain, Mich., may be included in this group of manufacturing towns in essentially non-industrial areas. Likewise the small towns of the Fox River district in Wisconsin have developed little beyond the paper industries, started early on the basis of local wood supply.

Quite different is the outlying industrial district of Quebec. In addition to the main center in Montreal, this includes the two railroad crossings of the St. Lawrence above that city (one of which, Cornwall, is in Ontario) and the small centers of the "Eastern Townships." The district has a considerable variety of industries, many of which depend largely on the tariff wall against American producers. The area in Quebec is widely separated from the other Canadian district in southern Ontario. All of the distinctly manufacturing cities of Canada are included in these small areas; while there is considerable non-local manufacturing de-

velopment in Sydney and New Glasgow, Nova Scotia, it is overshadowed in both cases by the much greater importance of coal mining.

On the Atlantic seaboard, the manufacturing belt reaches the coast from southern Maine to New York Harbor, excepting for Cape Cod Peninsula and most of Long Island. South of New York, however, its limit is the nearly straight line (only approximately the Fall Line) that connects the heads of the estuaries of New York, Delaware, and Chesapeake Bays, i.e. the direct rail line from New York through Philadelphia to Baltimore. The peninsulas of coastal plain between the estuaries in New Jersey, Delaware, and Maryland are definitely excluded. One small exception is the fine glass industry of Cumberland County, N. J., based on the local fine sands and, originally, charcoal from the local pine forests.

Other Manufacturing Areas

Outside of the main manufacturing belt, with its outlying districts, the map shows only one other area of importance —the South Atlantic Piedmont. In the Carolinas and Georgia the manufacturing is very largely limited to cotton-milling. The two tobacco centers—Winston-Salem and Durham—are important exceptions. Since a high proportion of the cotton mills are scattered in small towns, the area shows a large number of manufacturing places, but none of major importance. Only in the Carolinas, however, is the density of industrial towns comparable with that of the main manufacturing belt in the North. Nearly all the towns of this belt lie in the upper portion of the Piedmont, close to the mountains. Of the total of over seventy larger and smaller towns, not more than five are actually located on the "fall-line."

The belt of cotton-mill towns continues from Georgia into Alabama, joining the smaller steel towns of the Birmingham district. Possibly the few, somewhat diversified, centers of the Upper Tennessee Valley, in Tennessee, may be added to this general area.

The few towns shown on the Coastal Plain are all exceptional in character: Newport News—shipyards; Suffolk, Va.—food products; Hopewell, Va., a mushroom town created by a chemical industry during the World War; Waycross, Ga., a rail center with car shops; and Tampa, Fla., where Cuban tobacco is rolled into cigars. The few scattered points on the Gulf Coastal Plain from Mississippi to the eastern border of Texas represent little more than lumber-milling in association with the local logging.

Likewise almost all the places shown in the Northwest are small lumber-mill towns; one or two are smelting towns for local mining districts. Those in central California are either canning centers or specialized industrial suburbs of the predominantly commercial city of San Francisco. In all of the United States and Canada west of the line of the Mississippi, there is only one distinctly manufacturing city—the steel town of Pueblo, Colo.

Divisions of the Main Manufacturing Belt

Although the main manufacturing belt has both continuity and certain similarities throughout, notable differences in the major factors affecting the different areas exist within it which lead to great differences in extent and character of development. No attempt will be made here to present a full analysis comparable even with that of DeGeer, but a careful study of the map indicates the more significant divisions of the belt.

The Appalachian Mountains divide the manufacturing area fairly definitely

into an eastern and a western part, which are connected across the Ontario Plain-Mohawk Valley and to a lesser extent along two or three main rail routes over the mountains (notably, those of the Pennsylvania and the Erie Railroads). In each of these main divisions are five principal districts of concentration separated from each other for the most part by areas of lesser development. These ten districts with their outstanding characteristics are listed below.

A. *Eastern New England*—practically the entire manufacturing area of Maine, New Hampshire, and Rhode Island, and Massachusetts east of the Connecticut Valley. The map indicates clearly the special importance of the Merrimac River, Massachusetts Bay, and Narragansett and Buzzards Bay on the south. The most important dominating center of the area is of course Boston, though the bay ports on the south—Providence, Fall River, and New Bedford—are perhaps largely independent. This is an area of differentiated light manufacturing, with cotton goods and other textiles and shoes especially important. Specialization of individual cities in particular industries is more developed in this region than in any other: New Bedford and Fall River in cotton mills, and Haverhill and Lynn in shoe factories, for example. Boston and Worcester are most diversified.

B. *Southwestern New England*—Massachusetts and Connecticut west of and including the Connecticut Valley. This consists primarily of a string of cities along the Connecticut River, its pre-glacial valley south of Hartford, and along Long Island Sound to the suburbs of New York City. In addition there are important cities in smaller valleys of the Berkshires. This is likewise an area largely of diversified light manufacturing but with greater importance of metal products—electrical machinery, hardware, etc.—with textiles and paper less important. Its commercial center is not Boston but New York.

C. *New York Metropolitan District*

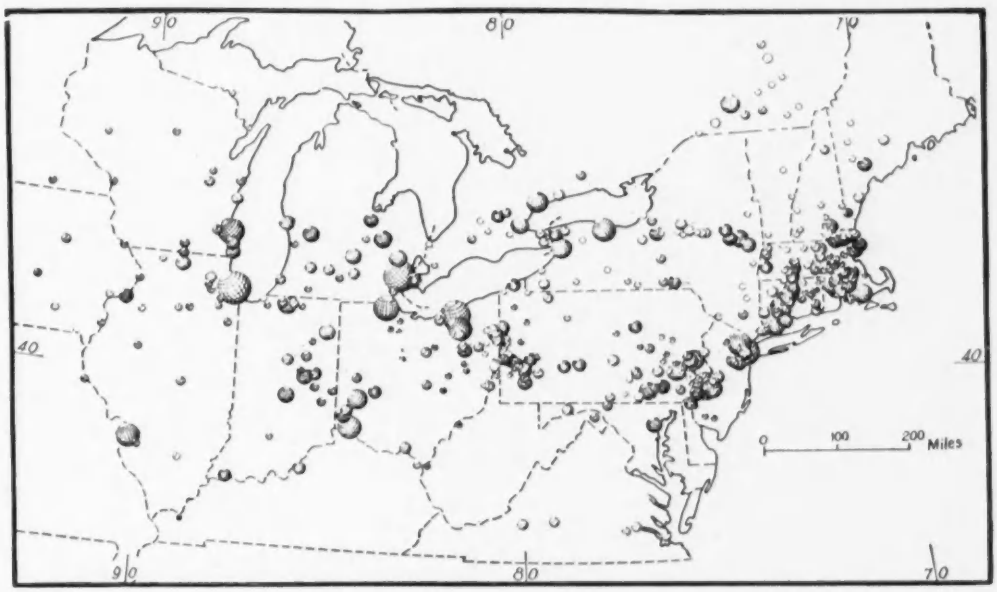

FIGURE 2.—Manufacturing cities of the main manufacturing belt of the United States and Canada. An enlargement of part of Figure 1.

—the small, concentrated area of New York City and its industrial suburbs in northern New Jersey, located on or close to New York Harbor. This is a district predominantly of secondary rather than basic industries including clothing, printing, and other industries characteristic of great economic and cultural capitals, and refining industries associated with export and import trade.

D. *Southeastern Pennsylvania*—including also a few cities in adjacent New Jersey, Delaware and Maryland. The two most important groups here are the tidewater centers from Philadelphia to Wilmington, Del., together with Baltimore on a similar but separate estuary, and the cities between those and the mountains, located for the most part along the valley routes between, of the Lehigh, Schuylkill, and Susquehanna Rivers. Perhaps no other region shows such a combination of heavy and light manufacturing, including iron and steel mills, textiles and a great variety of others. The major center of the region is, of course, Philadelphia, but a considerable part of the business and trade of the region, especially in the Lehigh Valley, is also oriented through New York. Baltimore, the southeasternmost point of the whole manufacturing belt, presents a somewhat exceptional character, not only in its relative isolation, but also in the small industrial development in comparison with its importance as a commercial port—approximately equal to Philadelphia.

E. *Mohawk Valley-Ontario Plain*—in central New York. This consists almost exclusively of a single string of cities along the Erie Canal-New York Central Railroad route from Troy through Schenectady to Rochester and Batavia, with a small branch along the Oswego Canal. Its industries, which are largely secondary, are similar in large part to those of western New England with which it appears to be more closely connected than with New York City. No dominant center exists within the region, but its business capital is undoubtedly in New York.

F. *Buffalo-Niagara-Toronto Region*—the area around the adjacent ends of Lakes Ontario and Erie, in western New York and adjacent Ontario. Possibly Rochester should be included in this region rather than in the former, but the character of its industrial development seems to place it better with the previous one. On the other hand, Buffalo with its predominant iron and steel and other heavy industries, is somewhat related to the region on the southwest (G). This region is complicated by the international boundary which, thanks to the tariff, presumably has caused greater development on the Canadian side than would otherwise be the case. The smaller centers on both sides of the line depend primarily on power from Niagara Falls. This is particularly important for the great chemical industries near the Falls. The region has two centers, in large part no doubt as a result of the boundary: Buffalo on the American side, Toronto on the Canadian.

G. *The Pittsburgh-Cleveland Region*—western Pennsylvania and eastern Ohio, including the Panhandle of West Virginia. This region between the Northern Appalachian coal field and Lake Erie is the main area of iron and steel and associated heavy industries of the continent. In addition to the dominant industries—iron and steel and their associated fabricating industries—it has a considerable diversity of other heavy industries, notably rubber tires, electrical machinery, motor vehicles, and glass. To a very important extent this region serves as the basic producer for the raw and semi-finished iron and steel materials used in all the eastern regions and regions H and J to the west. Its domi-

nant centers are, of course, Cleveland and Pittsburgh, with Youngstown, Akron, and Wheeling of somewhat less significance. The Youngstown district, Ohio-Pennsylvania, is highly specialized in the basic iron and steel industry; the Pittsburgh district, with many more iron and steel mills, also has a far greater development of fabricating industries of all kinds, as well as electrical machinery, glass, etc.; Cleveland is the most diversified. Akron, on the other hand, is concerned almost exclusively with rubber tire production.

H. *Southeastern Michigan District* —including also Toledo, Ohio, and the western end of the Ontario Peninsula. Practically every city included in this region is now highly specialized in motor vehicles (automobiles, trucks, etc.) and associated industries, with relatively little production of the basic materials. The all-important capital is Detroit. The Canadian portion is of minor im-

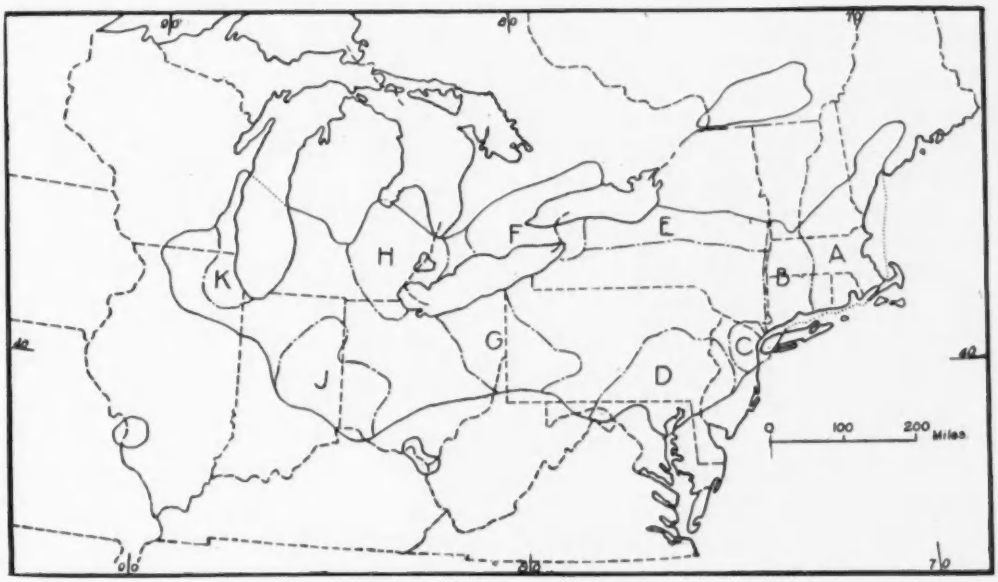

FIGURE 3.—The principal districts of the main manufacturing belt of the United States and Canada, are designated by letters. The districts are described at length in the text.

Location Factors	*Applies to Regions*
Major factors:	
1. Northern Appalachian coal field	All, especially G, D
Middle Appalachian coal field	H, J, K—somewhat A, B
2. Upper Lakes iron ore field	Indirectly to all; directly to G, K, F
3. Major Atlantic ports	C—A, B, D
4. Area of richest commercial agriculture	K—J, H, F
5. Trans-Appalachian routes to interior	Directly, E, F, G; indirectly, all Eastern
6. Great Lakes transportation	All Western excepting J; especially F, K, G; indirectly A, B, E, C
7. Belt of maximum "climatic energy"	All, especially A, B, C, E, F, H, K
Minor factors:	
8. Anthracite coal field	A, B, C (historically D)
9. Eastern Interior coal field	K, slightly; St. Louis
10. Water power	F, A, B, E (parts only)
11. Great urban markets (commercial)	C, K
12. Forest areas, for wood and pulp	B, F, H and Montreal area
13. Local iron ore mines	D and Ironton
14. U. S.-Canadian boundary	Montreal, parts F, H

portance; its chief centers are suburbs of Detroit. (Outside of this region the only cities in which motor vehicles and automobile manufacturing is the leading industry are South Bend, Ind., and Kenosha, Wis. There are also important automobile factories at Cleveland, Buffalo, Chicago, Milwaukee, and Indianapolis.)

The cities of western Michigan have not been included in the region because they have not shared in the automobile industry but remain centers chiefly of industries started with local forest resources: furniture at Grand Rapids and Holland, paper at Kalamazoo.

J. *Inland Region of Ohio-Indiana*—southwestern Ohio and central Indiana. This region alone of the western regions is distinctly removed from the Great Lakes. It has a somewhat indefinite position between the Middle Appalachian coal field and the rich agricultural corn belt, close to the principal Ohio River crossings into the Southern Interior. It has a diversified list of secondary metal industries, e.g., fabricating plants for electrical machines and refrigerators, wire, vehicles, etc. In general, its plants produce larger finished products for consumers, from iron or steel from the Pittsburgh-Cleveland region (or from Birmingham, Ala.). The most important section of this region is the Miami Valley from Piqua or Springfield through Dayton to Cincinnati. The portion in Indiana, between Fort Wayne and Indianapolis, is much less definite in real character. (Quite possibly this region should be extended north to include the line of cities that center on South Bend, Ind., although there is a marked break between. The character of industrial development is similar.)

K. *Lake Michigan District*—the west shore of Lake Michigan from Manitowoc, Wis., to Gary, Ind., and including the satellite cities a few miles inland from Milwaukee and Chicago. This is likewise an area in which heavy industries predominate; unlike the two neighboring regions (H, J) the region includes, in the South Chicago-Gary district, the basic iron and steel industries. But the secondary industries are relatively more important than in the Pittsburgh-Cleveland region, especially electrical machinery and appliances, railway cars, agricultural implements, motor vehicles, etc. Meat packing, chiefly at Chicago, is relatively more important than in any of the other regions, as one might expect. In addition, Chicago as something of an economic and social capital of the Middle West has a large development of such industries as clothing and printing.

It is this restricted district close to the shore of Lake Michigan which places the states of Illinois and Wisconsin statistically among the "industrial states" of the country. Nearly two-thirds of all the manufacturing of Wisconsin, as measured by wage earners, and nearly three-fourths of that of Illinois (as well as one-sixth of that of Indiana) is found in this small area. The extension of the district north from Chicago along the lake shore reflects the importance of the lake transportation, not only for ordinary lake shipping (coal especially) but also for the car-ferries from Michigan, which place all the ports as far as Manitowoc on a basis of rate equality with Chicago for shipments to and from the Atlantic seaboard.

A full interpretation of this manufacturing area would, of course, require a detailed study of the individual industries and districts, running into many volumes of reports; probably much of the necessary material would not be available. Nevertheless, certain factors stand out clearly from the present map.

especially if one compares it with the maps of coal mining, iron ore mining, and major transportation routes. Without attempting to give definitely the importance of the different factors, we will merely list them with the districts for which they particularly apply.[3] (The term "climatic energy" is used as defined and mapped in the well-known work of Ellsworth Huntington. Whether this is to be rated as the most important factor, as he appears to believe, or but one of the major factors, or even perhaps only a minor factor is probably still a matter of opinion rather than demonstration.)

In view of the importance of the Northern and Middle Appalachian coal fields, one of the major questions raised by the map of the manufacturing belt is the relative lack of development within and on either side of the Middle Appalachian coal field. In addition to the debatable question of climatic energy, two negative factors may help to explain that, namely, the scarcity of easy rail routes through the Middle Appalachians and the presence of negro slavery south of the Mason-and-Dixon Line and Ohio River. The slight development in Maryland as compared with adjacent Pennsylvania has already been noted particularly in reference to Baltimore, and the sharp line in the west marked by the Ohio River is certainly striking.

[3] Methods for evaluating such factors are given for the one of the major basic industries in R. Hartshorne: "Location Factors in the Iron and Steel Industry," ECON. GEOG., July, 1928, pp. 241–52, and for certain other industries in "Location as a Factor in Geography," *Annals Assoc. Amer. Geog.*, June, 1927, pp. 92–99, and in "The Economic Geography of Plant Location," *Annals of Real Estate Practice*, 1926, Vol. VI, pp. 40–76.

NEW COLONIES IN OLD QUEBEC

Harold S. Kemp

THE Province of Quebec, faced with the present problem of unemployment, has undertaken a remedial plan which not only has succeeded from the first, but, unlike most of the extravagant American sops, promises to be constructively advantageous to that part of Canada in the future. It is a plan which, while entailing "aid," does not undermine self-respect, deaden initiative, or foster the spirit of the dole.

In Quebec the government builds a new road—a move which in itself furnishes employment, but employment far different from the futile "puttering about" with an axe or a spade which characterizes many of our present government-suckled jobs. The new road

FIGURE 1.—Main Street of a new colony. Fifty miles of forest lie beyond the first narrow swath of clearing.

In brief, the Quebec plan consists of taking people from the more stricken districts—notably Montreal with unemployment typical of a great city in these times, and the asbestos mining region, where present conditions have thrown many men out of work—and planting them on the land, in their own homes, with their families. The five hundred dollars which the government allots to each family, and which becomes available only as needs arise, is to the last cent an investment, and not mere expenditure for subsistence. This sum must be regarded as capital which will expand, not as relief which is transitory. Such a plan, succeeding, means self-support, pride in ownership and achievement, and healthy citizenship, as opposed to the flabby civic spirit that is kept complainingly alive by political charity, whatever its disguise.

penetrates forested country; from it branch other roads. The region thus opened need not be remote: the colony which I have just studied (one of several, widely scattered) is twenty miles across the border from Maine—in the southern margin, then, of Canada. It is significant, however, that the country is forested, just as are thousands of square miles in Maine, one of the American States with both economic problems and resources similar to those of Quebec.

Into this forest the colonists are moved by the hundreds, not being set up in houses like those they have left, but in neat, snug log cabins. Each new owner, helped by a few government-

paid neighbors, builds his house under skilled guidance. Door-and-window frames, with sash, doors, and hardware are furnished, as well as shingles, flooring, and milled rafters. Very different, these trim dwellings, from the cabins of those other pioneers, our ancestors.

Each colonist is given 100 acres of forest-land in a strip sufficiently narrow to make neighbors the rule. Indeed the effect of the cabins along the road is that of a scattered village street.

The ten acres nearest the road are cleared of trees, the trunks of which, instead of being ruthlessly burned for lack of a market as in early American settlements, are floated downstream to the pulp mills at the edge of the forest, or are turned into boards at the government's temporary sawmill and shipped out over the government road to a railroad not remote.

The first few trees cut around the cabin, a garden is planted, and as the cleared area is increased, the "slashings," or branches, are burned and the land, though dotted with stumps, is ready for hay and buckwheat, first crops for beast and man.

In the fall, the colonist finds himself housed, a winter's supply of firewood stored, a little barn sheltering a cow and the hay-crop, and a potato cellar conserving a stock of home-grown food against the winter's cold and snow.

The cellar yields, besides potatoes, other vegetables equally suitable to growth in northern summers and to winter conservation: beets, cabbages, turnips, carrots. In the attic are stored onions and dried peas and beans—bases for daily hot soup and that filling dish, baked beans, which is by no means peculiar to Boston. Meat, this first winter, consists as far as the farm produce is concerned of eggs, but since deer are plentiful and each person capable of carrying a gun is allowed two during the season, there need be no time when frozen venison is not hanging ready for the knife and a quick grilling over wood.

FIGURE 2.—The nucleus of a future town. Church and school of St. Amelia across a first crop of buckwheat.

For desserts there are berries, the small fruits which are at home in a northern environment where the short summers will not mature tree fruits. The wild strawberries, raspberries, blueberries, and gooseberries which swarm into every opening in the woods and furnish important sequence in the diet of native bears, do even more for the settlers who can eat, in season, only a fraction of the available berries and who have an advantage over the bears in a winter supply of jams and preserves.

Varied and complete as is this list of first-year products, there are certain

FIGURE 3.—A typical cabin and barn still closely hemmed in by the great forest but with a fine patch of potatoes blooming in the front yard.

luxuries which are so nearly necessities in the present mode of living that they must be purchased. Tea, sugar, salt and kerosene make up the list, with a little of each sufficing; a bag of white flour is optional.

For these purchases the northern environment, rude as it may seem, is able to produce cash, and at the very moment of need. For with winter and the end of most farm activities, the farmer becomes lumber jack or mill hand, going deeper into the woods to work for one of the pulp or lumber companies. Moreover, the company's horses, used for "snaking" the timber to the nearest stream for the spring "drive," must have hay, and hay is the one thing of which the new farmer, with his lone cow, has a surplus. The adjustment of supply to demand is well-nigh perfect.

And so cash comes into the cabin, and with it those few purchases which round out the needs of the family. Bills for gas, telephone, electricity, rent, and the "family doctor" never appear. Far from contagion, illness is almost wholly limited to colds—perhaps to pneumonia —and to childbirth.

For pneumonia or a cold, flaxseed poultices bring the patient through almost as a matter of course, while the having of a baby is little more than an incident to break the monotony of a long winter and to prove the friendliness of a ministering neighbor-woman. As a matter of fact, this casualness as to illness is more general throughout the Province than in the settlement, for here the government provides a resident nurse, centrally located and proficient with snowshoes, whereas elsewhere in rural districts the herb-chest and the volunteer midwife are the rule.

If the provision for the settler's first year suffices, it is still better the second year, when another ten acres is cleared, barley, oats, and a little wheat have been added to the crops and a sow has littered. The cow too has contributed either a heifer calf toward the all-important dairy herd of future years, or a bull-calf which, before he is a year old, will have been "broke to harness" and set to hauling. Because a cart would require the purchase of wheels, the ox pulls, winter and summer, a home-made sled.

The ultimate destiny of such northerly farms, as far as producing a marketable surplus is concerned, is dairying—the making of butter in the settlements nearest quick transportation, and of cheese in more remote places, where the output can accumulate without deterioration until a full wagon justifies the long haul to a railroad. And although corn-growing seems, to most Americans, essential to hog-raising, the lack of corn in the north is offset by the abundance of skimmed milk or buttermilk in dairying regions. Moreover, here, where potatoes are much more at home than corn, the undersized or "runt" potatoes which are a part of the crop make excellent hog-feed, especially if cooked and added to barley. And so pigs are here, as everywhere, the logical "side-line" to dairying, and "Canadian bacon" becomes a high-priced commodity in the United States markets because corn with its high oil content makes fat, and the Canadian bacon is lean.

Pork, of course, is peculiarly adapted

FIGURE 4.—New cabin and first-year's clearing "back-country" from the Saguenay River. The pile of pulpwood represents spending money.

to preserving methods, and pigs on the farm mean not only ham, bacon, and smoked shoulders, but crocks of head-cheese and sausage, sealed with a layer of melted fat; lard for frying trout and potatoes and shortening breads and pastry; and perhaps most important of all to the settler, salt pork to add flavor and richness to the daily soup of peas, beans, or barley, and the pots of baked beans which alternate with meat dishes as supplier of proteids.

Moreover, the second spring finds the settler prepared to make his own sugar with the boiling-down of maple sap, and this sugar, in spite of its distinctive flavor, is used for all purposes, making "flavoring extracts" superfluous in cake, and glorifying the flavor of cheap tea.

Wheat, which could not have contended against the onslaught of weeds in newly cleared and plowed land, is able to take the place of the more contentious buckwheat in the second year, and so the heavy, rather bitter breads and *crêpes* of mixed buckwheat and barley flour give way to a lighter, more digestible, and altogether delicious bread of whole-wheat flour.

Thus of the original "store-goods" required, only tea, salt and kerosene remain to be bought and those heavier drains on the exchequer, sugar and wheat flour, become a part of the farm's contribution.

With time a little flock of sheep—ten on the average—evolves from a purchased ewe, and the busy housewife adds the carding, spinning and weaving of heavy homespun to her other duties. This cloth she makes into blankets and clothes for herself and man—clothes of such cast-iron durability that they are refashioned for successive offspring and the wool from ten or even eight sheep suffices to dress the family even though woolen and not cotton clothing is worn in the cool summer. Rayon and silk, of course, not being indigenous, are simply not in the picture.

The scheme, as it has worked out, is progressive in that ten acres of land and no more may be cleared each year. When the plan was put into operation three years ago without this provision, unscrupulous "settlers" cleared off a large part of their land immediately, sold the timber and decamped. Whereupon the government very cannily put on the brakes, as it were, and by slowing up the process of land-clearing assured the need of cultivation if the settler was to live.

That he—and his family with him—can live and amass goods, is already a proven fact. In sitting down frequently to a thick soup as the chief item of the meal, he is merely following custom which prevails among French families

FIGURE 5.—An eleven-year old hay-maker and an eleven-months old "ox" with a typical home-made hay sled.

wherever found. In enjoying, without thought of monotony, potatoes twice a day or oftener, he but makes himself brother to millions of Americans who do the same. On the other hand, he eats speckled trout, venison, and pheasant as necessities—commonplaces—of life, nor knows what luxuries they are to rich populations to the south of him. His is a hearty appetite and it is satisfied fully and—possibly excepting the first year in the settlement—with greater variety than is asked for by many housewives.

The deprivations are not, then, those of comfort or sustenance. The pioneer's life, now as ever, lacks the trimmings which, perhaps unfortunately, we Americans have come to regard as life itself. There are no automobiles, radios, telephones, movies, golf clubs. There are no orgies of shopping in seductive department stores. Style ceases to be a god and pretension is no longer a goal. The settler has his land, his home and beasts, and his successful handling of a job in which to take pride. He has his family to love and to be loved by, and incidentally he has—and it cannot be otherwise in his world—a wife who is a help-mate; a partner in endeavor and labor. There can be no parasites in the clearing.

At the end of ten years there is a farm of 100 acres, some of it newly cleared and good only for hay and buckwheat or flax between the stumps, but most of it well-broken land, free from stumps, surface roots and boulders. With the last tree cut, the fostering income from merchantable timber comes to an end. But in Quebec farmers whose great-grandfathers cleared the land which they now plow, go back into the wooded hinterland to work in winter lumber camps, and the new settlers would feel themselves shirkers, blind to opportunity, if they too did not continue as farmer-woodsmen rather than farmers only.

FIGURE 6.—A farm in the making. The third-year cutting, with cleared fields beyond.

As established farmer the settler's former timber sales are replaced by the sale of cream to the butter factory. Grains and vegetables are still important only in-so-far as they are to be consumed on the farm. The land then, excepting a patch here and there, is given over to hay and grazing cattle. The forest, where it bordered on the road, has become that most placid of landscapes—a dairy country. And the self-subsisting settler within the wilds has become an exporter, since England buys his butter.

In evaluating the success of Quebec's answer to the depression, one must recognize certain fundamental advantages in what we of softer lives are apt to consider a forbidding environment.

The forest—an obstacle to be overcome—is the prime factor in making its own conquest possible. The game which it and its streams have sheltered is a very significant contribution to the success of the first years. The presence of unlimited fuel makes the long winter tolerable, and the heavy snows which, beginning in November, thickly blanket the earth until late April or May are less a handicap than a blessing. They offer a smooth surface for log-hauling throughout a region in which roads are made with difficulty and are consequently rare and probably poor.

The forests are evidence of another favorable factor in that they are located not alone by soil, but by rainfall suffi-

FIGURE 7.—Cabins are small but the barns are made large for future crops of hay. So hope looks ahead in the colonies.

cient to nourish great growths. Hence, even in this last year of our worst drouth, Quebec was moist and green, her berries hanging heavy with juice, her trees far less subject to summer fires than ours, and her fields green with grass and grain. The colonist faces no danger of a fatal break in his ten-year plan through drouth.

In soil new to the plow and to sown crops there is an advantage in immunity from plant diseases and pests common in old farming regions. And if the winters are severe and long because of northern latitude, this is compensated for in a degree by the long summer days which are a concomitant of this latitude. Thus the shortness of the summer season is offset somewhat by the 17 or 18 hours of daylight in contrast to 14 or 15 in our corn belt and the even half-day, or 12 hours, on the equator. On the other hand, if one is to be wholly fair, seventeen hours of daylight does not mean necessarily as many hours of warm sunlight for rapid plant growth, and this last advantage must all too often be discounted because a climate which boasts of its frequent rains must confess to many days of leaden skies and lowering clouds.

The success of the forest colonies is to be measured by the mean of the advantages and disadvantages of the region in which they are located. And since the plan is admirably suited to, and asks not one iota more than, that mean, or average, the plan is succeeding. This third summer found the swaths through the woods widening, the stumps in the first-cleared ten acres rotted sufficiently to have been pulled out, and the herds and flocks augmented in accord with both the plan and nature. The government has punctuated the thin lines of settlement with school houses and, at further intervals, with churches, and has furnished teachers and visiting nurses, while the church recognizes the emergency by furnishing priests who ask no tithes and take up no collections.

The thing works. The people—men, women and children—are happy and

FIGURE 8.—Thus last year's forest becomes this year's field of buckwheat.

healthy and talk of their lives with a sense of triumph. They have worked hard—already through the worst years—and they can't stop now; the goal is too well in sight. Ex-miners and former city dwellers agree, "this is the life." And there is promise that life for them means renewed life for Quebec.

I should like to say, "What they have done, we can do." But I dare not. Spoiled by past years of prosperity; confirmed in our opinion that what cannot be wrung from our environment may be wrested from our Treasury; sophisticated in money-making and spending, how many are there, however hit by the "depression," who are willing to turn to the hard work and simple life of a primitive agriculture? The Canadians who, in 1934, are beginning life again in the wilderness are not sophisticated. Their past life up there to the north of us has not established them in that present familiar class which, not too proud to accept charity, is still too proud to work with back and hands and hearts.

RISE OF THE PORT OF VANCOUVER, BRITISH COLUMBIA

Leah Stevens

VANCOUVER, Canada's greatest port on the Pacific Coast, is situated at the foot of the Coast Ranges of British Columbia near the Fraser River, yet not on it. Actually the port is on the south shore of Burrard Inlet, a fiord arm of English Bay (Figure 1). The rise of this port, particularly in recent years, has been quite phenomenal. In the short period of seven years between 1921 and 1928, this port changed from an inconspicuous lumber and small exporting center to one of the leading grain ports of the world.

Stages of the Rise

There have been two stages in the rise of the Port of Vancouver. The early stage may be called the Lumber Export Stage. It began in 1887 when the Canadian Pacific Railway was connected with the port, and ended in 1921 when the first commercial shipments of bulk grain were made from the port. The second stage may be called the Grain Export Stage. It began in 1921 and continues during the present time.

Lumber Export Stage, 1887–1921. Vancouver, like a number of other Pacific Coast cities, really began as a logging camp and sawmill. "Lumber was indeed the genesis of Vancouver, for there was a lumber mill, the Hastings Mill, on the south shore of Burrard Inlet long before there was any Vancouver." [*Harbour and Shipping, Monthly Journal of Canadian Shipping,* (Vancouver), Chap. XII (Feb., 1929), p. 57.] The Hastings Mill was built in 1866, but there was a sawmill, the Moodyville Mill, established on the north shore of the inlet in 1865. Between

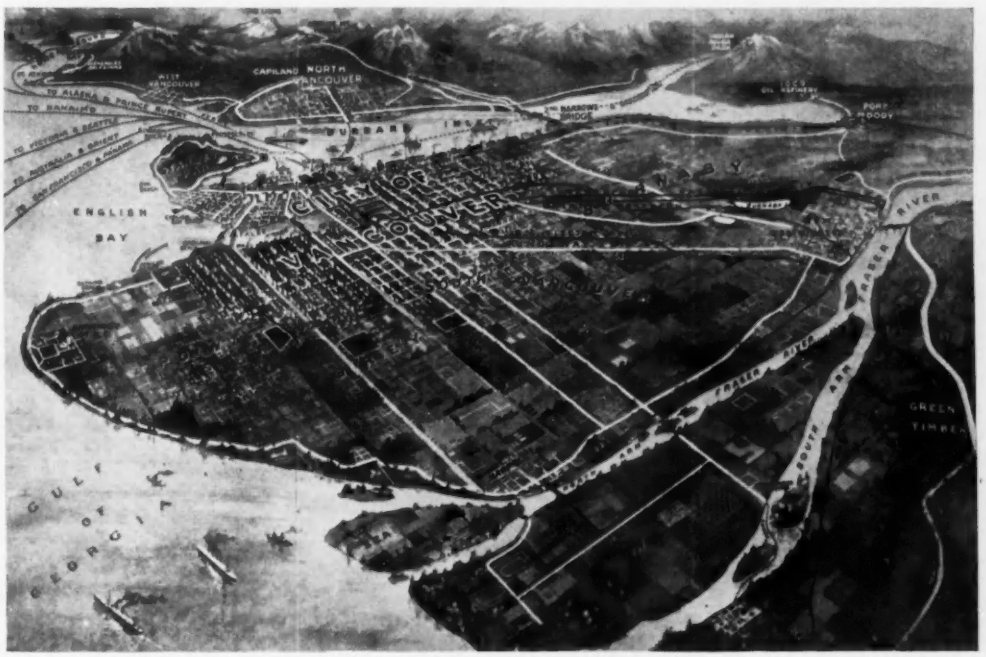

FIGURE 1.—Topographical map of Vancouver and surrounding territory. (Courtesy of the Industrial Department of the Vancouver Board of Trade.)

Burrard Inlet and False Creek there was a fine stand of Douglas fir, giant cedar, and hemlock (Figure 2). The largest and best timber was near the coast and was extraordinarily accessible due to the many inlets. By 1887 fifty vessels had left the harbor laden with lumber.

During most of the period in which lumber was the principal export from Vancouver, the water front gave a very

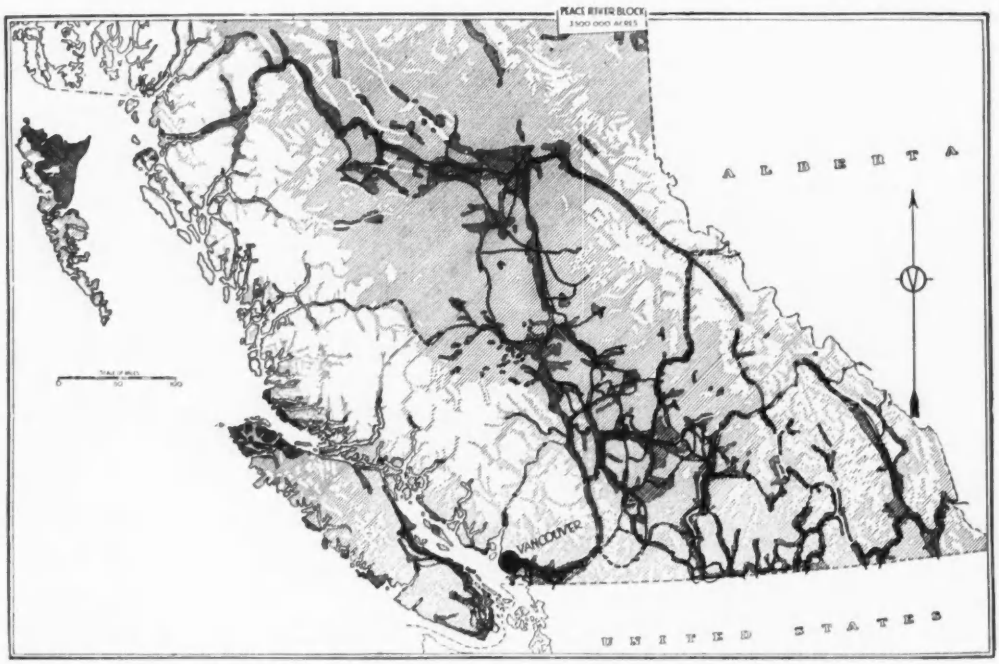

FIGURE 2.—Standing timber in the Vancouver area. Cross hatching indicates timber stands; lands suitable for agriculture are shown in checks. (Courtesy of Industrial Department of the Vancouver Board of Trade.)

different appearance from at present. Buildings along the shore were horizontal wooden warehouses and anchorages of an inconspicuous nature (Figure 3). At the close of this period there were on the south shore of Burrard Inlet twelve deep-sea piers and docks with a total capacity of twenty-three vessels. The piers were all located in the western end along the south shore of the inlet. False Creek shores then were little used by lumber companies (Figure 4). The north and east shores were used as they are now by the Canadian Pacific, Great Northern, and Canadian National railways (Figure 4).

The infant lumbering community of Vancouver would probably have dwindled to nothing, but for the coming of the Canadian Pacific Transcontinental Railroad in 1887. This railroad was responsible for most of the development of the port up to 1913, nearly the close of the Lumber Export Stage. The Canadian Pacific originally terminated at Port Moody, but was extended in 1887 to the western end of Burrard Inlet. Thus the Canadian Pacific secured the most advantageous position along the whole southern waterfront. The Canadian National Railway was formed by the amalgamation of the Canadian Northern and the Grand Trunk Railway in 1916. But this railroad did little to further the development of the port until the second stage of the port's development.

Growth was comparatively slow dur-

ing this first stage of the port's development. The principal export during this first stage was lumber. In 1906 British Columbia shipped 49,000,000 board feet of lumber of which approximately half came from Vancouver. By 1912 British Columbia lumber exports had increased to 57,000,000 board feet, of which 25,000,000 board feet came from Vancouver alone.

Deep-sea vessels and steamship lines serving the port increased in number from 71 vessels with a net tonnage of 1,163,699 in 1920. There were only twelve ocean steamship lines operating regularly to the port in 1912, three to the United Kingdom, three to the Orient, one to Australia, three to the United States, and two to Mexico, Central and South America. The average number of deep-sea sailings was twelve per month. By 1920 the ocean steamship lines had almost doubled and the average number of deep-sea sailings per month had more than doubled. Greatest gain was shown in the liner sailings to the United Kingdom and the Continent, to the Orient, and to the United States ports.

The value of the imports exceeded the value of the exports during this whole period of early growth. In 1909 the value of the exports was only 50 per cent as great as the value of the imports. The value of the imports in 1920 was 12½ times the value of the imports in 1909, while exports increased 19½ times in value during this same period of years.

Grain Export Stage, 1921–1934. While the general volume of export trade in Vancouver has greatly aided in its growth, it is as an outlet for Canadian grain that the port has achieved international importance. Vancouver, the youngest of the established and recognized seaports of the world, is the pioneer on the Pacific Coast of North America in the export of bulk grain. Ports such as San Francisco, Portland, Tacoma, and Seattle had handled grain years before the first elevator was built in Vancouver, but the greater per cent of the shipments from these ports was in sacks.

The first elevator in Vancouver was built under the direction of the Honorable H. H. Stevens, a member of the Trade and Commerce Commission of Canada. It was completed in 1914, the same year that the Panama Canal was finished. During the first years of its existence, it was practically unused and

FIGURE 3.—The first wharf built by the Canadian Pacific on Burrard Inlet in 1889. (Courtesy of The Vancouver Harbour Commissioners.)

was by many people dubbed "Stevens' Folly" or "Stevens' White Elephant." [James H. Hamilton, *Western Shores* (Vancouver: Progress Publishing Co., 1932), Chap. XI, p. 163.] Less than ten years after its construction it broke all records of any elevator of its size in the world in the quantity of grain shipped.

Many difficulties, however, had to be overcome before grain could be encouraged to flow in any great volume to the western coast of Canada. The first difficulty met by the port was at the outbreak of the World War in 1914. Grain was needed in Europe, but there were no ships to carry grain, or anything else for that matter, from the Pacific ports. The elevator remained idle.

The second difficulty arose from the fact that there were many doubts as to

the feasibility of carrying grain in bulk through the tropics to Europe by way of the Panama Canal. (The earliest shipment of grain in sacks was exported from Vancouver in 1909.) These doubts were likely aroused by interests connected with the long-established movement of grain eastward by way of Atlantic Coast ports. In 1918 and the early months of 1919 the government, as an experiment, shipped 800,000 bushels of wheat in the holds of five steel steamers. On every ship were chemists of the Grain Research Laboratory who watched the grain every day and made tests as to its temperature and moisture content. They carefully supervised the unloading at the port of discharge in England. The result was a complete justification of the route by western ports. The grain was pronounced in excellent condition.

Two-thirds of the fight was won, but the remaining third, that of convincing shippers that the "Western Route" was commercially practicable, was the most difficult part of the fight. Trade is always conservative; it always takes considerable time to turn trade from an old established route to a new and untried one. There was already much money invested in grain handling facilities on the Great Lakes, in Montreal, and on the Eastern Coast of Canada and the United States. Up to 1917 practically every bushel of Canadian grain had been handled quite adequately by these ports. Railroads had up to this time made provisions and rates to suit this eastern route. They were exceedingly uninterested in the western route, and especially so since it meant a reduction in their revenues because of the shorter rail haul. The wheat lands of Canada are for the most part nearer the Pacific than the Atlantic coast. These railroads would not readjust their rates on grain shipped west to agree with rates eastward. It was a long and strenuous fight. Between the years 1921 and 1927 the grain rates from Calgary to Vancouver were reduced eleven cents on a bushel. How-

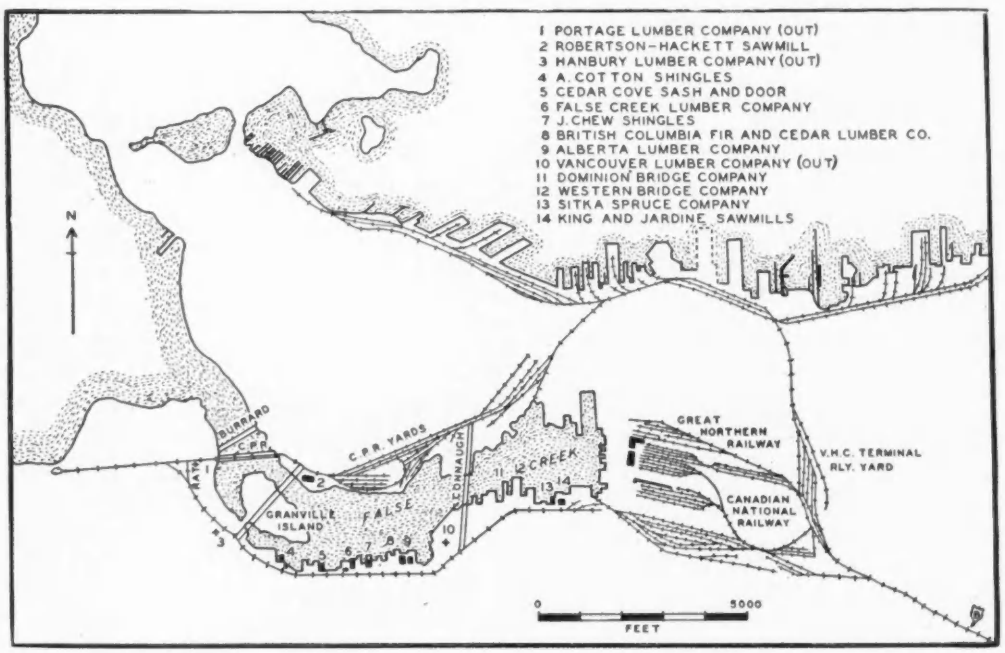

FIGURE 4.—False Creek area showing railroad yards and sawmills.

ever, the 1932 grain rates west per 640 miles still show a difference of two cents per hundredweight in favor of the eastern route, but grain from Alberta can now be shipped economically to world ports through Vancouver.

The first commercial shipment of bulk grain from Vancouver was made in the steamer *Effingham* to the United Kingdom in 1921. The 2,048 tons on this ship were sold free on board by the Alberta Pacific Grain Company, Ltd.

With the coming of the grain trade, port forms in Vancouver changed materially. Vertical structures, tall gray grain elevators stand out conspicuously in most views of the port in 1933 (Figure 5). Until 1923, even, the grain storage facilities of the port were limited to one unit with a storage capacity of 1,250,000 bushels. The years 1923 and 1924 were a period of rush construction to provide adequate facilities to meet the increased volume of commodities, chiefly, grain which had with such a struggle been encouraged to move through the port. In eighteen months, between 1923 and 1924, the elevator capacity of the port of Vancouver increased from one and a fourth million to over six and a half million bushels. At the close of this period, in 1933, there were seven elevators with a storage capacity of 17,843,000 bushels situated on Burrard Inlet. This is nearly double that of the total elevator capacity on the Pacific Coast of the United States. Seattle, Tacoma, Portland, Oakland, and Los Angeles have only a combined capacity of 9,945,000 bushels.

Other changes have occurred in port forms due to increased grain trade and trade accompanying grain trade. Deep-sea piers and docks have been added until in 1931, there were 24 deep-sea piers and docks along the shore of Burrard Inlet. These piers and docks are capable of accommodating 62 vessels at one time. Important port forms added during the Grain Export Stage, other than elevators, were Ballantyne pier, completed in 1923, the new Canadian Pacific Pier B-C, completed in 1927, the Canadian National Timber Pier, completed in 1930, the Great Northern Railway Pier, the Terminal Dock and Warehouse, and the Vancouver Harbour Commissioners' Terminal Railway (Figures 6 and 7). Total expenditures for port facilities during the period were 60 million dollars.

FIGURE 5.—Piers B-C, D, and H of the Canadian Pacific. The tall vertical structures in the right background are grain elevators. (Courtesy of J. H. Hamilton.)

False Creek area, which was little developed in the Lumber Export Stage, became the industrial part of the port during the Grain Export Stage. The south shore is lined with sawmills and shingle mills (Figures 4 and 8). In the west end of False Creek, Granville Island, land reclaimed from the creek, is now crowded with important industrial plants making iron, steel, and wood products.

As explained earlier, the Canadian Pacific had first choice along the Burrard waterfront and it successfully kept other railroads out of the port for a number of years. In 1916 the Canadian Northern and the Grand Trunk, which was built to Prince Rupert, amalgamated to form the Canadian National Railway. However, it is only through courtesy that Vancouver can be called the terminus of

the Canadian National Railway because this railroad ends at Port Mann fifteen miles distant. From Port Mann this railroad uses the tracks of the Great Northern over the Provincial Toll Bridge at Westminster to the False Creek railroad yards. Then it is again dependent upon other railroads, the Great Northern, the Harbour Commissioners' Railway, the B. C. Electric, or the Canadian Pacific for its entrance to Burrard shore. On some occasions more than one railroad is used by the Canadian National before the main waterfront on the south shore of the inlet is reached (Figure 4). It was due, no doubt, chiefly to this handicapped position of the Canadian National that the Terminal Railway of the Harbour Commissioners was built.

Since 1920, the Harbour Commissioners, the Canadian National Railway, and the Canadian Pacific Railway companies have all carried on considerable port development. Large government loans have helped in erecting expensive port facilities.

Marked growth in the total trade of Vancouver has occurred between the years 1921 and 1929. But grain, of course, has shown the most phenomenal increase in volume during this stage of the rise. The amount shipped from Vancouver in the calendar year of 1924 showed an increase of 415 per cent over the amount exported in 1921. By 1932 the grain exports from Vancouver had risen to 105,006,925 bushels, almost double the 1924 exports. In 1932 grain made up 70 per cent of the total exports from this port.

Other exports than grain have shown a less marked increase. Lumber, however, the oldest export commodity from British Columbia has, up to the time of the depression, shown a marked growth. The total shipments from British Columbia to overseas countries increased 366 per cent between 1920 and 1930. Shipments from Vancouver alone increased almost 93 per cent between 1920 and 1930. There was a decline of 35 per cent in the lumber shipments from Vancouver between 1930 and 1932.

FIGURE 6.—Ballantyne Pier, the largest pier in the port. (Courtesy of J. H. Hamilton.)

Canned salmon shipments from Vancouver showed a marked increase of more than 56 per cent between 1921 and 1925, but since that year there has been a gradual decline until in 1932 the shipments were little more than those of 1921. Variation in demand for certain varieties of salmon other than sockeye and overfishing the Fraser River or waters adjacent to that stream are in part responsible for this decline.

Lead and spelter exports in 1927 were four times those in 1921, but since that year these exports have also shown a

decline, until in 1932 they were only one and one-half times those of 1921. Examination of other export statistics for this same period of years, 1927–1932, show a decided increase in tons of bar metal exported from Vancouver.

Fish meal, fertilizers, and fish oils have been manufactured on the British Columbia coast for many years, but it was not until 1925 that this industry assumed any large volume. In 1924 a law was enacted permitting the use of certain food fish, particularly pilchards, for industrial purposes which up to this time had been forbidden. Since this law was enacted, the export of oil from pilchards has increased from a negligible amount in 1924 to 3,204,058 gallons in 1930.

FIGURE 7.—Terminal Dock and warehouse. In the right background is the Midland Pacific Elevator.

The number of ships entering the port has increased greatly during this stage of growth. In 1921, 496 ocean-going vessels with a capacity of 1,165,699 net tons entered the port. By 1922 this number had nearly doubled and so had the net tonnage. In 1932, 1,123 deep-sea vessels with a net tonnage of 4,501,734 entered the port. Between 1921 and 1928 the number of deep-sea vessels increased 260 per cent. The growth has been due partly to the greater number of regular liners operating from Vancouver to Europe. All types of vessels have shown a 25 per cent increase in number between 1921 and 1932. [Annual Reports of Vancouver Harbour Commissioners, 1922–1932.] The number of deep-sea vessels and the average net tonnage of the vessels entering the ports of Montreal and Vancouver are approximately identical. So far as imports and exports are concerned, Montreal has a better balanced trade than Vancouver. This, however, applies only to the most recent years due to growing imports and diminishing exports of Montreal. In the case of Vancouver, exports have grown at a more rapid rate than the imports. During the calendar year, 1929, Vancouver for the first time beat Montreal in volume of foreign exports. The figure was 3,651,342 tons for Vancouver and 3,343,772 tons for Montreal. Montreal was still far in the lead in foreign imports in 1929. Montreal imported 3,256,000 tons of commodities while Vancouver imported only 1,776,000 tons.

FACTORS CONTRIBUTING TO THE RISE

Opening of the Panama Canal. The rise of the Port of Vancouver may be traced to the opening of the Panama Canal in 1914, but growth was so retarded by the World War that marked increase in trade did not occur until after 1917. The canal has given the port an entirely new strategic position as a shipping point for agricultural products of a

large part of Western Canada and for the forest and ore products of British Columbia. By this achievement the Pacific Coast has been brought much nearer to Europe. Shipment of grain in bulk from the Pacific Coast to Europe was impracticable until the canal opened. This port now successfully competes with Atlantic ports for all year round trade with the United Kingdom. The canal route also shows its effect upon the quantity of lumber shipped to the Atlantic Coast of America. A large intercoastal lumber trade which used to be handled overland by railways has been opened up. Before 1914 practically no lumber was shipped from British Columbia to the Atlantic Coast, while in 1929, 300 or 400 million board feet annually were shipped from British Columbia to this market. Forty or 50 million board feet are sent annually to the United Kingdom and Continent, as against 10 to 15 million board feet prior to the opening of the Panama Canal. The canal makes a saving of 25.1 days or 5,666 miles from Vancouver to Liverpool, and a saving of 22.5 days or 5,528 miles from Vancouver to Hamburg.

The Panama Canal has made possible a very much lower ocean freight rate as a result of shortened distance and time than was formerly available between Europe and the Pacific Coast. This reduced rate has resulted in a larger proportion of the imports required by Western Canada being brought in through the Port of Vancouver rather than through eastern ports.

Increase in Area of Wheat Land and Wheat Output of the Prairie Provinces. The wheat lands of Canada are rapidly moving westward to the Pacific Coast. Between 1908 and 1922, Saskatchewan multiplied her production of wheat seven times, Alberta increased her production tenfold, but Manitoba's production remained practically unchanged. In the twelve years between 1911 and 1923, Saskatchewan's acreage under wheat doubled, Alberta's acreage increased three and one-half times, while Manitoba's acreage remained practically stationary. Nine-tenths of all the wheat lands of the Dominion are in the prairie provinces of Saskatchewan, Alberta, and Manitoba.

Reduction of Freight Rates on Grain Shipped Westward. Since sea transportation is cheaper than land transportation, taking a point midway between Port William at the head of the Great Lakes and Vancouver, it is cheaper to ship via Vancouver and the Panama Canal than via Fort William, the Great Lakes, and the North Atlantic, especially if rail rates are no higher moving westward than moving eastward. Before 1924, the cost per mile for shipping freight was considerably greater moving westward than moving eastward. In 1923 it cost eleven and one-half cents more to ship a bushel of grain the same distance westward than it did eastward. Between 1921 and 1927 owing to a vigorous campaign waged by the Provincial Government of British Columbia, a series of reductions in grain rates per bushel to Vancouver were made. The eleven cents reduction on 80,000,000 bushels shipped through Vancouver amounted to a saving of $5,351,651.00 to the farmers in 1927.

Grain now from all Alberta can be shipped economically to world markets via Vancouver. However, it still costs two cents more per hundredweight to ship grain 640 miles westward than it does to ship it eastward from the Prairie Provinces. And Vancouver is the only port to which there is a difference between rates on grain for export and for domestic use. Rates on grain shipped for domestic use are double those on grain shipped for export.

The tributary area of Vancouver is

mainly Alberta, but occasionally shipments come from western Saskatchewan, especially in winter when the St. Lawrence waterway is closed by ice.

Development of New Markets. The shipment of grain, largely wheat, in bulk from the Pacific Coast to Europe was impracticable until the Panama Canal opened. The United Kingdom and Continent may, therefore, be considered as an important new market for wheat. Grain exports to this country alone have grown from 4,552,158 bushels in the 1920–1921 crop year to 84,375,953 bushels in the 1932–1933 crop year. [Annual Statistical Report of the Vancouver Merchants' Exchange, 1932, pp. 1, 8.]

Vancouver is more favorably situated than any other North American port to capture the growing trade of the Orient. The distance is shorter from this port and the Canadian Pacific boats make the voyage in one day shorter time than other Pacific boats. Japan and China are turning increasingly from rice to wheat flour as a staple food, and they favor the hard wheat of Canada. The annual volume of wheat shipped to this Oriental market has grown from practically nothing in 1920 to approximately thirteen million bushels in the 1931–1932 crop year.

Improved Port Facilities. Efficient and speedy movement of commodities through a port tends to invite shippers to increase the amount of goods sent via that port. In the case of Vancouver it is difficult to determine whether the increasing trade caused the improvement in the port facilities or whether the improvement in port facilities is responsible for the increased trade. At any rate, hand in hand with the increase in volume of trade has gone the improvement in port facilities by government commission and by private interests, until today Vancouver is one of the finest ports on the Pacific Coast of America.

FIGURE 8.—Robertson-Hackett sawmill on False Creek.

Changes in Port Administration. Before 1913 development of the port was slow and depended wholly on private enterprise, mainly on the Canadian Pacific Railway Company. In 1913 the Vancouver Harbour Commissioners were incorporated by an act of parliament and were given power to develop the harbor. A capable engineer was engaged to plan for and report on a scheme for development. The World War prevented the Commissioners from putting these plans into effect for several

years. Meanwhile, private concerns began constructing piers and docks. Since then the Commissioners have expended large sums obtained as loans from the Dominion Government in constructing piers and elevators. The Commission also made and administers the filled area known as Granville Island in False Creek and leases the land to industrial concerns.

The port authority at present is a board of three commissioners appointed by the government and serving for an indefinite period. The Commission has the power to appoint a harbor master, deputy harbor master, deputy shipping masters, and such other offices, assistants, engineers, clerks, and servants as seem necessary. The Harbour Board makes by-laws for the government and regulation of the port.

Shipping Connections to Major Trading Areas. In part the rise of Vancouver may be attributed to the regular liner sailings to world markets. The average monthly liner sailings in 1926 to the United Kingdom and Continent were 17, to the Orient 15, to Australia 5, to the United States excluding Puget Sound 20, and 3 to Mexico and Central America. These figures indicate a decided increase over the 1921 liner sailings.

SUMMARY

There have been two marked stages in the rise of the Port of Vancouver, the Lumber Export Stage and the Grain Export Stage. The former extended from 1887 to 1921 and was a period of slow growth and meagre port development. The Grain Export Stage, which extended from 1921 to the present time, on the other hand, was a period of spectacular rise of bulk grain shipments and somewhat less marked increase in other exports. Imports lagged far behind exports in tonnage during this latter period.

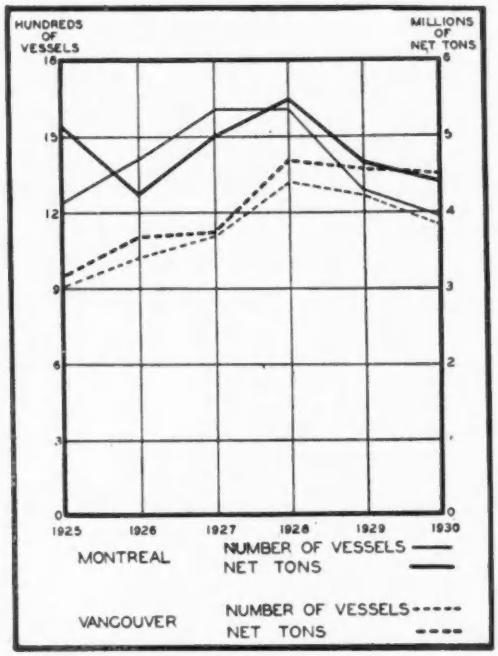

FIGURE 9.—Number of vessels and net tonnage of the vessels entering Montreal and Vancouver from 1923 to 1930 inclusive.

The various forces influencing this growth of the port were: (1) The opening of the Panama Canal, (2) increase in wheat acreage of the Prairie Provinces, (3) reduction in freight rates on grain shipped westward, (4) development of new markets, (5) improved port facilities, (6) changes in port administration. Of these forces, the opening of the Panama Canal has seemed to be most influential. Change in port administration has, it seems, done least to further the rise. Most of the port development has been financed by private interests such as the Canadian Pacific and Great Northern Railway Companies.

NOTE.—Statistics used in this article were obtained principally from J. H. Hamilton, secretary of the Merchants' Exchange of Vancouver and editor of the Harbour and Shipping, Monthly Journal of Canadian Shipping, Progress Publishing Company, Vancouver, B. C., and from the Annual Reports of the Vancouver Harbour Commissioners and the Vancouver Board of Trade.

VITICULTURE IN OHIO

Paul Cross Morrison

TRAVEL that portion of northern Ohio bordering Lake Erie and you will no doubt be impressed by the importance of the vine in the agricultural economy of the region. Anticipating questions likely to arise in such event, it is the purpose of this paper to review certain aspects of the development and the present organization of grape production in this state.

Importance and Location of Vineyards

With roughly the equivalent of 15,000 acres devoted to the vine, Ohio is normally exceeded only by California, New York, and Michigan in grape production. Of the fruit and berry crops grown in the state, commonly only apples, and in some years peaches and strawberries, exceed grapes in farm value. Worth $795,000, the 1934 crop totaled 22,720 tons. Although this was only about one and one-third per cent of the national production of 1,775,168 tons, the amount gains significance with the knowledge that approximately eighty-six per cent of the national aggregate originated in the state of California where production is largely of the European type grape. Ohio is, therefore, one of the leading producers of the American type grape (Table I).

Not only this, but the degree of concentration of Ohio vineyards into a relatively limited area calls for interpretation. Slightly more than four-fifths the total number of vines of bearing age are located in the counties bordering Lake Erie (Figure 1). Further, the majority are in the northern part of these counties, within a few miles of the lake shore. They thus form one of the more important vineyard concentrations outside of California. Other important concentrations are found in the Chatauqua and Finger Lakes districts of New York; the Benton Harbor and Paw Paw districts of southwestern Michigan; the Springdale district of northwestern Arkansas; and Erie County, Pennsylvania.

TABLE I

Grapes—Production by States[1]

State	*1919 Short Tons*	*Average 1926–30 Short Tons*	*1934 Short Tons*
California	1,345,000*	2,182,000*	1,544,000*
Michigan	57,936	61,888	61,145
New York	76,242	79,296	49,400
Ohio	20,861	23,784	22,720
Pennsylvania	21,340	21,344	18,981
Arkansas	1,222	9,443	16,640
Missouri	5,475	9,996	7,540
Others	47,511	58,903	54,760
United States	1,575,587*	2,446,654*	1,775,186*

* Includes some quantities not harvested on account of market conditions.

[1] Bureau of Agriculture Economics: estimates of the crop reporting board.

For the country as a whole grape production increased steadily during the decade 1919–28, reaching a peak of 2,649,739 tons in the latter year, but has since declined. Production in California was greatest in 1927, amounting to 2,406,000 tons. In Ohio the crop tended to increase up to the year 1931, when 31,000 tons were harvested. Michigan exceeded New York in production for the first time in 1932.

The vineyards, usually operated by their owners as a part of a larger fruit, truck, or general farm enterprise, probably do not average much over five acres in size, with the largest covering only about fifty acres. In a general way they form a belt, although several centers of heavier acreage, separated by areas with fewer vines, are distinguishable. The concentration of greatest consequence lies east of Cleveland. Towns identified with this area are Perry, Madison, Unionville, and Geneva. West of Cleveland considerable acreage is located near Avon and Dover, while a third

major concentration is found in the vicinity of Sandusky and on North Bass, Middle Bass, South Bass, and Kelleys Islands near by (Figure 2).

VARIETIES GROWN AND USES

Probably more than ninety-five per cent of the grapes produced in the vineyards east of Cleveland are Concords. Most of the remainder are Niagaras. Westward the Concord gradually loses its dominance until, at the western end of the grape belt near Sandusky, the Catawba is the leading variety. Niagaras are also fewer here, but there are significant plantings of Ives and Delaware (Table II).

TABLE II

PER CENT OF TOTAL GRAPE ACREAGE IN DIFFERENT VARIETIES, 1924

Variety	*Ashtabula County*	*Lake County*	*Erie County*	*Ottawa County*
Concord	99	95	35	22
Ives		*	8	3
Catawba		*	52	66
Delaware		*	3	8
Niagaras	*	4	*	1
Others	*	1	2	*

* Less than 1 per cent.

From C. J. West: "Ohio Commercial Orchards and Vineyards," *State of Ohio Department of Agriculture Special Bulletin*, April 1, 1926.

The earliest plantings in northern Ohio were largely of the Catawba variety. Conditions on the islands and near Sandusky proved ideal, and here this quality grape is still the principal variety grown. Further east along the lake shore, however, the Catawba, because of its need for a long growing season, was not so well adapted and was soon replaced by hardier varieties, particularly the Concord.

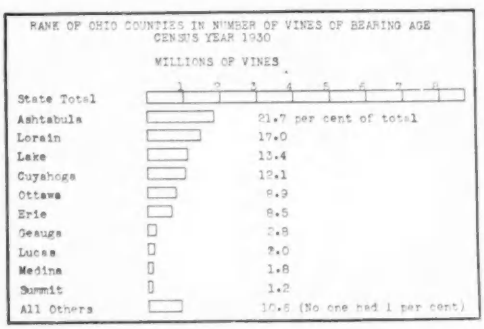

FIGURE 1.—Production from year to year being a variable factor depending on environmental influences, it may in general be inferred that the number of vines of bearing age in the different counties serves as an index to the average relative importance of these counties in grape production.

The Concord is the American grape most widely used for table fruit and the manufacture of grape juice. In addition, it is what might be called a bulk wine variety. Used in the manufacture of port, Burgundy, and claret, it is also the native variety most widely used in the preparation of "Dago Red" and other such home-made wines.

The Catawba, a fair table grape, is supreme among native varieties for the making of fine wines. From it are made white sweet wines, white dry wines, and white sparkling wines or American champagne. Its juice is also used for blending purposes, but because of its late ripening date and susceptibility to fungous diseases this grape is at its best in only a few favored areas. Chief of these are the Central Lakes district of New York, and the Sandusky and Island district of Ohio.

The Delaware, a red grape, is not only a fine table grape, but it is used in the making of an excellent white dry wine of the same name, and for blending in the manufacture of expensive wines such as champagne. The small size of the berries, the low yield, the poor vigor of the vines, and susceptibility to mildew prevent its wider growth. The Niagara, a white variety, is a good all purpose grape. The Ives, a poor table grape, is used chiefly for making a red wine of the claret type.

EARLY IMPORTANCE OF THE CINCINNATI AREA

Grape growing in Ohio began with the work of Nicholas Longworth, of Cincinnati, who established his first vineyard about 1822. Shortly after, in 1825, Longworth received cuttings of the Catawba from Major John Adlum, of the District of Columbia, who had introduced this grape as the first dependable American variety in 1823. These Longworth cultivated so success-

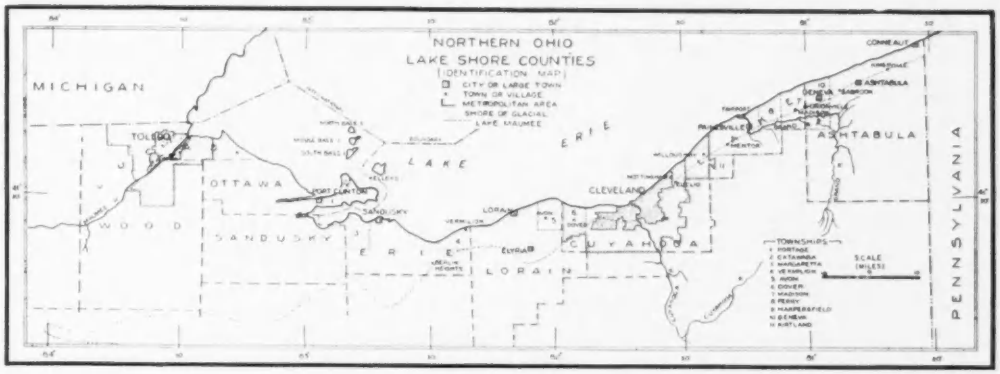

FIGURE 2.—Not only is the production of grapes in Ohio largely confined to counties along Lake Erie, but it is also localized in rather definite areas within these counties. In Ottawa County most of the vineyards are on North Bass, Middle Bass, and South Bass Islands, and in Portage and Catawba Townships. In Erie County the heaviest acreage is on Kelley's Island, and in Margaretta and Vermilion Townships. In Lorain County the greatest concentration of vineyards is in Avon Township. The same is true of Dover Township in Cuyahoga County. East of Cleveland, the heaviest acreages are found in Madison and Perry Townships, Lake County; and Harpersfield, Geneva, and Saybrook Townships, Ashtabula County. Harpersfield Township has the largest acreage of any township of the state, while the five above named townships together compose the most important vineyard concentration in the state. Though formerly so, the Euclid-Willoughby section of Cuyahoga and Lake Counties is today of little importance.

fully that he became the first vineyardist in the eastern states to establish a vineyard on anything like a permanent basis, and the first to make wine on a large scale.

Continued over more than one hundred years, all previous attempts to cultivate the vine in eastern America had been failures because they were based on varieties introduced from Europe. Such vines winter killed, succumbed to attacks of fungous disease induced by the summer heat and humidity, or were destroyed by phylloxera, a root parasite to which native varieties are largely immune. But not until the nineteenth century was it generally realized that success depended on use of types derived from the indigenous vines.

Once launched, viticulture in the vicinity of Cincinnati increased rapidly. By 1845 the area planted to vineyards totaled 350 acres; by 1852 more than 1,200 acres; and by 1859 about 2,000 acres. Several factors favored this development. For a number of years it was generally supposed that the Ohio Valley had the most favorable climate for grape growing in the nation. As a result, and since the industry promised large profit and was a local project under daily observation, necessary capital for its promotion was quickly forthcoming. Newly arrived German immigrants, many of them from the wine districts on the Rhine, provided a cheap but skilled supply of labor. Moreover, Cincinnati at that time was the largest interior city of America; the inland capital of agriculture, migration, transportation, and manufacturing. Not only did the city itself, with its large German population, provide an important market, but the reaching of other interior centers where foreign wines were expensive and difficult to obtain was relatively easy. The Cincinnati wines even competed to a limited extent with the foreign brands in eastern seaboard cities. Like the cured pork and whisky, for which Cincinnati was also so well known, the wines were a concentrated, well keeping product of considerable value in comparison to the raw materials involved in their manufacture.

The Cincinnati area probably reached

its peak production and importance about 1859. In that year grapes were shipped for table use as far away as New Orleans. This was not the common practice, however, for the demand for wine purposes was generally such that price precluded the sale of grapes for table use. Consequently the U. S. Census reported production in terms of gallons of wine. In 1859, Ohio led all other states with a production of 568,617 gallons, which was about thirty-five per cent of the national total. Of the Ohio total, Hamilton County alone accounted for sixty-two per cent, while the counties next in order of importance were Brown, Clermont, Montgomery, and Butler. Thus, the Cincinnati area, with its terraced, vine-clad hills, may be said to have been the first successful and for a time the leading center of grape and wine production in the United States (Figure 3).

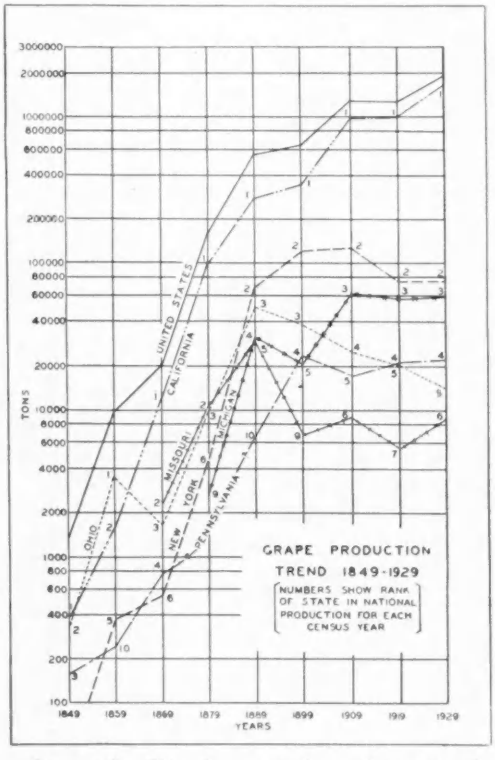

FIGURE 3.—The above trends can be accepted only as approximate since the crop in any census year may be somewhat above or below normal. For example, it appears that the trend in Ohio was downward between 1919–29. That this was not true is shown in Figure 4.

RISE OF THE LAKE REGION, 1860–1880

For several years previous to 1859, however, the grape crop of the Cincinnati region had suffered considerable damage from mildew and rot. Although this created much apprehension, the heavy crop of 1859 was heartening, it being the best since 1853. Nevertheless, havoc of the disease was repeated in ensuing years. Vineyard abandonment began and by 1870 grape culture in the vicinity of Cincinnati had become almost a thing of the past.

Meanwhile, a start in viticulture had been made along the shore of Lake Erie as early as 1836. Although theoretically at too high latitude for success, it was soon discovered that the grape throve there. Extensive plantings took place just previous to 1860, and these increased rapidly as the Cincinnati vineyards were abandoned. In fact, plantings assumed such a speculative nature and were so heavy in the Sandusky and Island section during the middle years of the decade, 1860–1870, that this has been referred to as the time of the "grape fever."

Not only was the certainty of a crop greater in the lake region because of a greater freedom from fungous disease and climatic hazards, both very important factors, but the cost of planting and cultivating a vineyard there was less. The lighter soils did not require the heavy expenditures for trenching and manuring necessary on the heavier clays of the Ohio Valley, while the more level nature of the topography obviated terracing and made possible the greater mechanization of cultural operations. In addition, the pioneer vineyardists of the region had evolved a set of cultural

practices which, for the American grape, were superior to the European practices the German immigrants had perpetuated in the Cincinnati area.

Access to markets also being satisfactory, the above advantages no doubt would have eventually caused the center of grape production to shift to the lake region. Thus, it is probable that the destruction of the Cincinnati vineyards by disease merely hastened this change. By 1869, only about eight per cent of the Ohio vintage was produced in Hamilton County. Erie, Ottawa, and Cuyahoga counties were all of greater importance.

Naturally a temporary decrease in Ohio's production accompanied this change. The total for 1869 was less than half that for 1859, and amounted to only about seven per cent of the national aggregate. Both California and Missouri were now more important than Ohio as producing states. Many of the newer vineyards in the lake region had not yet come into full bearing. Others were not highly productive because much of the planting during the "fever period" had been unwisely done. It has been estimated, for example, that at least half the 10,000 or more acres planted during the middle sixties had been abandoned by 1876. Apparently the acreage destroyed was more than replaced by plantings of a more productive nature, however, for production increased rapidly during the years, 1869–1889 (Figure 3).

Ohio probably reached its peak acreage and production during the closing years of this period. In 1889, there were some 33,000 acres of vineyards in the state; more than twice the amount existing today. The greater part of this acreage was in the lake counties, for although a number of vineyards had at one time or another been started in the interior of the state, the majority of these were soon abandoned. Production amounted to 50,556 tons; 38,947 tons being sold for table use; the remainder to wineries. The market value of the crop was $2,881,692; that of the wine manufactured $1,083,506. The grapes sold for table use reached markets scattered from the Rocky Mountains to the Atlantic Ocean; hundreds of carloads of grapes being shipped from Dover, Euclid, Vermilion, Sandusky, and other grape belt stations. In 1888, some 350 carloads rolled from Euclid Station, Cuyahoga County alone.

A Declining Production, 1890–1920

During the next three decades acreage and production of grapes in Ohio steadily declined. By 1909 the state had dropped to fourth, and by 1919 to fifth, among the producing states. Since then Ohio during some years has been fourth, and during others fifth, in relative importance.

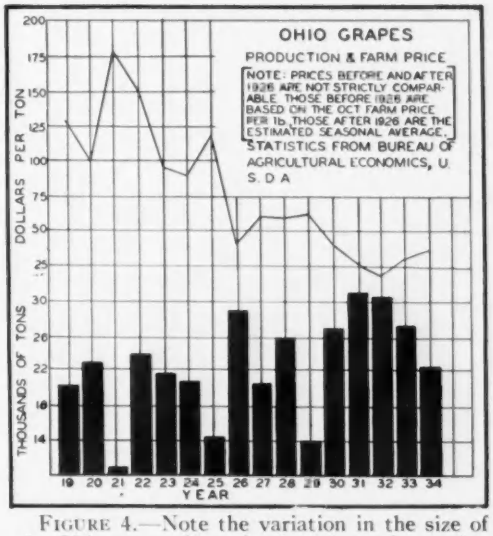
OHIO GRAPES
PRODUCTION & FARM PRICE
NOTE: PRICES BEFORE AND AFTER 1926 ARE NOT STRICTLY COMPARABLE. THOSE BEFORE 1926 ARE BASED ON THE OCT FARM PRICE PER lb. THOSE AFTER 1926 ARE THE ESTIMATED SEASONAL AVERAGE.
STATISTICS FROM BUREAU OF AGRICULTURAL ECONOMICS, U. S. D. A
DOLLARS PER TON
THOUSANDS OF TONS
YEAR
19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

FIGURE 4.—Note the variation in the size of the Ohio crop. Even in the lake region spring freezes, frost, drought, frigid winters, and other adverse climatic factors often cause partial crop failure. In 1929, for example, an unseasonably warm period in late March was followed by light freezes and protracted near freezing temperatures, with much rainy weather during April and early May, thus preventing proper pollinization. There is also a tendency for the vineyards to bear heavier every other year, since the vines probably grow the best buds to produce the following year's grapes when bearing a light crop.

This decrease was probably due largely to the fact that shrinking profits, incident to increasing competition of grapes from New York, Michigan, Pennsylvania, and California in table grape markets formerly supplied by Ohio vineyards, successively created and eliminated many marginal producers. Eating grapes being a semi-luxury, their market was further restricted by the nation wide industrial depression during the middle nineties.

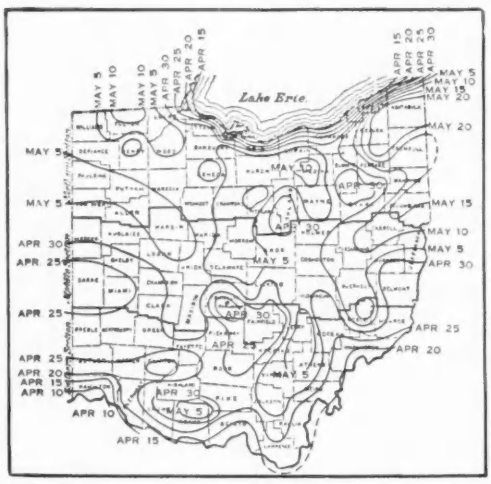

FIGURE 5.—Average dates of the last killing frost in the spring. (Reprinted by permission from *The Climate of Ohio*, by William H. Alexander and C. A. Patton, *Ohio Agricultural Experiment Station, Bulletin 445*, 1929, p. 49.)

The problems of some Ohio vineyardists became still more complicated when damage of their vineyards by rot assumed serious proportions in 1898 and 1899. As damage spread, first in Ashtabula and Lake Counties, then westward into Cuyahoga and Lorain Counties, many vineyards were abandoned. Others were sadly neglected. In Ottawa County, a movement which started in the late eighties replaced many of the vineyards with more profitable peach orchards.

As the national demand for Ohio grapes for table use decreased, however, a new market outlet for the crop developed. Shortly after 1900, and earlier in some cases, the large increase of foreign populations in the rapidly growing industrial centers of the state created a local demand for bulk grapes to be used in the home manufacture of wine. The local demand for grapes for eating, sweet juice, and jelly purposes also increased as the urban population grew. As a result, the abandonment of Ohio vineyards was not as great between 1909–1919 as it had been during the previous two decades.

Eleven counties, mostly in the northeastern part of the state, even enjoyed acreage increases. But in Cuyahoga County, where the growth of Cleveland caused many vineyards to be taken over as residence and industrial sites, acreage continued to decline. Partly because of the effects of several severe winters and the ravages of rootworm, the same was true of Erie, Ottawa, and most of the interior counties of the state. Although prices obtained for grapes increased steadily after 1912, increases in costs of production were such that net return on vineyard investment was still poor. Prices in 1918 were the highest in many years. The next year (June, 1919) the "War Time Prohibition Act" became effective, to be followed by "Constitutional Prohibition" in January, 1920.

THE PROHIBITION YEARS

Between 1920–1930, the number of grape vines in Ohio increased slightly more than thirty-five per cent; in the nation as a whole about forty-five per cent. Contrary to expectations viticulture in the United States was not ruined by the passage of the 18th Amendment, but stimulated. Since the so-called hard liquors did not so readily lend themselves to home manufacture as did wine, homemade (and bootleg) wines were soon in part substituted for them, as well as for

the former legal wines, part of which were the imported product of foreign vineyards.

The result was an increased demand for grapes. Prices were high for several years, particularly in 1921 when there was a short crop in both California and the eastern states. Encouraged by these high prices and the apparent possibility of handsome profits, producers set out grape vines, and then more grape vines. Since a grape vine takes three or more years to come into bearing, the supply of grapes could not at once be increased. Overplanting resulted, particularly in California, and a few years later supply exceeded demand. Prices as a result declined. After 1929 prices were forced still lower by the sharp reduction in demand which accompanied the depression. The middle and lower classes, particularly those of foreign extraction, have been generally hard hit by the depression. Since these classes form the principal market, the sale of grapes has suffered in accordance with their reduced purchasing power.

The increase in vineyard acreage in Ohio between 1920 and 1930 has been indicated. Surprisingly enough, however, Ottawa and Cuyahoga, among the grape belt counties, had fewer vines at the end of the period than at the beginning. Still more surprising, in view of its general effect, the 18th Amendment was partly the cause for the decreased acreage in Ottawa County. Here the Catawba was the principal variety produced. Since much of each pre-prohibition year's crop of this grape found a special market in bonded wine cellars, particularly those in and around Sandusky, prohibition closed the most important market. Forced to find a new outlet, the Catawba did not seem able to compete successfully with the Concord, already strongly intrenched in the urban bulk markets. Quality was not necessary for the home manufacture of wine, and the Concord, because of its hardiness and heavier production per acre, was cheaper and easier than the Catawba to produce. In addition, the exhaustion of the soil of many island vineyards had so weakened them that they were no longer profitable.

In Cuyahoga County the decreased acreage was largely the result of the rapid growth of Cleveland during and after the World War. Not only were some of the vineyard lands utilized for residential and industrial purposes, but the speculative subdividing of much of the land of the county, with its accompanying increase in taxes, forced many of the agricultural population out.

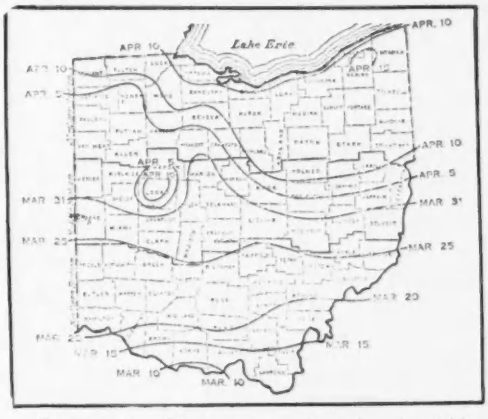

FIGURE 6.—The advent of spring in Ohio. Making its first appearance in southern Ohio, spring then advances north across the state, taking about thirty days to reach the lake. Here the date in any one year depends largely upon the amount of ice formed on the lake the previous winter, being later at the eastern end of the lake because of the easterly drift of the ice and cold water, and because of the higher latitude. The advent of spring as shown was considered to have arrived when the daily mean temperature reaches 44° F. (Figure reprinted by permission from *A Climatological History of Ohio*, by William H. Alexander, *The Engineering Experiment Station, Ohio State University, Bulletin 26*, 1923, p. 109.)

As shown by Figure 4, although the peak prices paid for Ohio grapes were received in 1921, prices continued high from 1918 through 1925; after that year they declined perceptibly. Production

FIGURE 7.—Abandoned vineyard. A typical scene in Cuyahoga County, both east and west of Cleveland, where the speculative subdivision of much of the land in expectation of the further growth of the city has forced many of the rural population out.

costs were not proportionately reduced, however, so that the drastic decline occurring after 1929 resulted in greater and greater losses to growers. In 1932 the average farm price for Ohio grapes reached a record low of $18.00 per ton, with much of the crop finding no market. Not even the most efficiently operated vineyard could return a profit under such conditions.

As was generally true for the country as a whole, practically no new plantings were made in Ohio after 1927. As prices continued to decline, the tendency among some vineyardists was to neglect or abandon their vineyards; among others to fertilize and otherwise help their vineyards to an increased yield, thus taking advantage of the fact that many vineyard costs are fixed regardless of yield per acre. Seemingly, the latter were in the majority for the complete or partial abandonment of vineyards was not as great as might have been expected.

As in the case of the tree crop industries, the heavy planting of vines in times of high price subjects viticulture to alternate boom and depression periods. This being true, past experience has shown that the man who constantly keeps his vineyards in good condition has the best chance of profit in the long run, providing of course that his vineyards are well located. Prices were slightly better in 1933—largely due no doubt to the smaller crop and the anticipated repeal of the 18th Amendment—and were still better in 1934, when they averaged $35.00 per ton. Thus, it is hoped by many Ohio growers that grape production will soon again be on a profitable basis.

CLIMATIC RELATIONSHIPS

The present localization of the Ohio grape industry may be interpreted largely in terms of climate.

The northern varieties of the American grape do best in regions having equable temperature conditions, a fairly constant atmospheric circulation, and a minimum of fog and dew during their growing and maturing period. Comparatively low temperatures, averaging 55 to 65 degrees during the growing months of May, June, and July, and higher temperatures, averaging 65 to 75 degrees, with much sunshine, during the maturing months of August, September, and October are optimum. Precipitation should fall within the limits of four to six inches each for the growing months, and two to five inches each for the maturing months. Regions having large daily and annual temperature ranges, sudden changes in temperature, or late spring and early fall frosts are not satisfactory. (Data from U. P. Hedrick, *et al.* "The Grapes of New York," *15th Ann. Rept. N. Y. Dept. Agr.*, Vol. 3, Part 2, 1908, pp. 69–70.)

Since precipitation is about equally suited for grape culture in all parts of Ohio, it is largely the effect of the waters of Lake Erie on temperature that causes the climate of the lake region to more closely approach the conditions associated with viticulture than does that of any other part of the state. The lake influence retards the advance of spring

until danger of frost is past, mitigates the extremes of heat and cold, both seasonal and diurnal, and delays the occurrence of frost in the autumn. As a result, only a corner of southeastern Ohio enjoys a longer frost-free growing season, and there the danger of spring frost damage is greater, as is shown by a comparison of the spring frost dates with those for the advent of spring (Figures 5 and 6).

That the above are important advantages is evident, for even in the lake region there is some frost damage during certain years. This increases rapidly with distance inland, and is greater at the eastern end of the lake than at the western. However, not even the lake shore vineyards near Sandusky can produce the late maturing Catawba variety as successfully as is possible on the islands near by where damage from spring frost is almost unheard of, and autumn frosts are often two to four weeks later than on the mainland.

The more or less constant motion of the atmosphere during the growing season gives the lake region another decided advantage for grape culture. Land and lake breezes are generally well developed on days when anticyclonic conditions, with clear skys and faint barometric gradients, would ordinarily bring stagnant air conditions. As a result the vineyards do not suffer greatly from mildew and rot.

The comparative lack of heavy fogs and dews during the late summer also tends to reduce damage of this type. This absence of fog and dew is not a result of a greater dryness of the atmosphere, but may be explained by the more equable state of humidity and diurnal temperatures resulting from the lake influence.

FIGURE 8.—Abandoned vineyard near Dover. The beach line of Glacial Lake Warren, known locally as North Ridge, can be seen in the background.

BIOLOGIC FACTORS

Black rot, powdery mildew, and downy mildew are the most common diseases affecting the vineyards. The probability of damage by these diseases being less in the lake region than elsewhere in the state was a very important factor in the concentration there of the majority of the state's vineyards. This is clearly apparent when it is remembered that effective methods for controlling black rot and mildew were not discovered until the late years of the last century.

Of the insects attacking Ohio vineyards, the grape berry worm, the grape leaf hopper, the grape root worm, the

grape flea beetle, and the rose chafer are economically the most important. Ordinarily there seems to be a greater prevalence of these insects in the lake region than elsewhere. This is probably due largely to the greater expanse of vineyards there, which enables the rapid spread of the insects and increases the probability of their year to year perpetuation. Perhaps too, the lake region is naturally more suitable for insect development. In central and eastern Ohio, for example, where the destruction of the crop by frost as often as once every four to six years leaves few grapes upon which berry worms can live, this pest is controlled naturally.

FIGURE 9.—Vineyard vista. A well-cared-for vineyard near Vermilion. Grapes are an intensive crop requiring much labor in the trellising, pruning, tying, cultivation, and spraying of the vines, and in the harvesting of the fruit.

Arsenate of lead, bordeaux mixture, and nicotine sulphate are the most common spray materials used in pest control activities. Which is used, and how and when, depends on the pests being combated. Probably more vineyard acreage goes unsprayed than is sprayed. In many cases this results in inefficient production of grapes, but not always so. Often the individual vineyardist finds it more profitable not to spray because of the small amount of damage done by the pests. Spraying is more common in the larger vineyards, since they can more easily carry the overhead of a power spraying machine and are as a rule better managed (Figure 11).

Spraying is also more common west of Cleveland, because of the greater prevalence there of the highly destructive berry worm. The ruling in 1926 of an arsenic residue tolerance of .025 gr. for fruit in domestic trade, and its subsequent reduction to .01 gr., created a problem of special import in these vineyards. Effective control of the berry moth requires a spray application late enough to be effective against a second brood of worms, but such an application causes the residue on the fruit to exceed the amount permissible by law. Whereas many of the growers formerly sprayed three times a year, they can now spray but twice. However, newly recommended cultivation practices have aided in control of the berry worm and the solving of this problem.

TOPOGRAPHIC RELATIONSHIPS

Fringing the south shore of Lake Erie are lake plains and beach ridges attesting the higher water levels existing during glacial times. East of Berlin Heights, Erie County, these plains form only a narrow strip between the lake and uplands, either the Portage escarpment of the Appalachian Plateaus or the bordering morainic ridges, three to fifteen miles to the interior. Where the uplands approach close to the lake shore they generally mark the southern boundary of commercial grape production in the lake counties. The vineyards of Harpersfield township, Ashtabula County, form a notable exception, however, being located within the uplands, on the slopes of the Grand River Basin.

Forming a narrow extension of the lake plains inland for a number of miles, this valley is 200 to 250 feet deep in some places. Thus the drainage of cold air from points along and adjacent to its upper slopes probably explains the localization there of vineyards. No doubt the human factor has also played

a part, since a large percentage of the acreage is cultivated by a settlement of Jewish farmers. Regardless, these vineyards suffer more from frost than those located on suitable lake plain sites.

Just west of Cleveland the edge of the Appalachian Plateaus bears away from the lake toward central Ohio and the lake plains become wider, particularly so west of Berlin Heights. Nevertheless, most of the vineyards here are also located within three or four miles of the lake, illustrating the basic importance of the lake influence as a limiting factor to the distance inland the vineyards normally extend. In short, the plateau edge or the morainic ridges serve as a limiting factor only when they lie close enough to the lake to restrict the inland extent of the lake influence.

Marking the surface of the lake plains, two or more low sand and gravel ridges running roughly parallel to the shore can usually be distinguished. These are old beach lines of Glacial Lakes Warren, Whittlesey, and Maumee. Just west of Cleveland, and east of that city to the Pennsylvania border, these ridges are close together and near the lake shore, though not always continuous. Here the slopes to the ridges and the higher portions of the inter-ridge areas, especially those having light soils, are the portions of the lake plains most intensively utilized for vineyards, truck gardens, nurseries, and orchards.

Being as a rule better drained, the light soils of these areas are warmer and more friable than the poorly drained clays of the lower portions of the inter-ridge areas and many sites immediately along the lake front. This higher soil temperature causes the growing season to arrive several days earlier, while better air drainage causes these sites to be freer of frost—both distinct advantages for the above uses. There are many vineyards on clay soils, however, particularly west of Cleveland, but the lower and poorer drained sites are always avoided. Grapes from these clay soil vineyards are considered by many to be superior for wine purposes because they seem to develop a higher sugar content.

The number of vineyards north of North Ridge is limited. West of Cleveland the same is true of the number of vineyards south of Middle Ridge. Although many early vineyards were planted immediately adjacent to the lake shore, the superior suitability of the ridge slopes and other sites a short distance inland was soon recognized. In lake front sites the cooling influence of the water in spring and early summer was often even more than sufficient for frost protection, thus causing the development of the buds to be retarded more than need be, and the maturing period to be lengthened. Many of these sites also proved undesirable because of poor drainage. Others were abandoned because of the increasing demand for the land for recreation and summer home uses.

FIGURE 10.—Cultivating a vineyard near Sandusky. In the larger vineyards where the amount of work to be done is sufficient to justify its purchase, a tractor requires less time to cultivate an acre, and because of its steady pull and greater power it does a better job than does machinery drawn by horses.

It should not be concluded, however, that vineyards are continuous along the old beach lines. In some places the ridges are too far from the lake. Again, the vineyard concentration is stronger

FIGURE 11.—Use of power spraying equipment in a vineyard near Vermilion. During the years when the vineyard is coming into bearing, and for several years thereafter, there is frequently no spraying required. As the vines become older, diseases and insects are more likely to establish themselves and make regular spraying necessary.

at certain points because of an early start, or because of the near-by location of a wine press in earlier times. In other places the suitability of the soil for truck gardens, nurseries, poultry farms, and other uses has limited the amount of land available for vineyards.

The largest concentration of vineyards along and adjacent to the ridges is found near the towns of Perry, Madison, and Unionville, in Lake County. Other important concentrations are found near the ridges in the vicinity of Dover, in Cuyahoga County, and Avon, in Lorain County. The above vineyard areas are easily viewed from the main east-west highways which follow along the ridge crests.

SOIL RELATIONSHIPS

Since soils similar in nature to those utilized for vineyards in the lake region, or others just as well adapted, are available in other parts of the state, it can be said in general that the soil factor was not highly important in determining the present localization of these vineyards. The soils used vary considerably, ranging from the fine sands, gravelly fine sands, gravelly sands, gravelly fine loams, and other light soils of the old beach ridges, to the clay loams, silt clay loams, and clays of the uplands and inter-ridge areas. It is not fertility so much as sufficient drainage that is most important in determining the adaptability of a soil for viticulture.

In the past, vineyard fertilization has usually been done in a desultory manner, if at all. This and the limited use of green manuring cover crops accounts in part at least for the low average yield of many of the vineyards. If the soil had the necessary mineral and humus content to begin with, such has since been depleted. Realizing this, more and more of the progressive vineyardists are using cover crops and are scientifically applying fertilizers.

HARVESTING AND MARKETING

The harvesting of grapes in the grape belt starts the latter part of September and extends through October. Delawares are ready for picking first, followed by Concords, then Ives, and finally Catawbas. Since table grapes must be solid enough to withstand excessive crushing and bruising in packing and shipping, they are usually picked just as soon as thoroughly colored and sweet enough to be palatable. Solidness of the fruit is not a necessary quality in juice grapes, however. This being true, and the sugar content of the grapes becoming greater the longer they hang on the vines, juice grapes are generally not picked until well ripened.

The grapes are ordinarily packed in the field directly into the containers in which they are to be marketed. If they are to be sold for juice or jelly purposes, as are most Ohio grapes, they are seldom graded and no more than ordinary care is taken in packing them into the uncovered half-bushel baskets in which they are commonly marketed. Grapes for table use, on the other hand, are usually graded. The clusters are then

carefully packed into the standard two or four quart "Poney Baskets."

The obtaining of sufficient labor for harvesting is seldom a problem. Most of the pickers are women and children who live in the neighborhood, supplemented at times by help from the cities near by. In either case the laborers usually live at home and drive or walk to and from work. An exception occurs on the islands where pickers from the mainland are often provided with living quarters for the duration of the harvest. Pickers are either paid by the basket or by the hour, often depending on whether the vineyard is a light or heavy producer. When filled, the baskets are removed from the vineyard by hand or on flat-top wagons.

As distinguished from that of the other grape states, the marketing of the Ohio crop is characterized by: (1) The local or near-by nature of the market; (2) The importance of the motor truck in moving the crop to market; (3) The number of direct to consumer, or direct to manufacturer, sales.

Very few Ohio grapes are marketed outside of the state. The most important market is the Cleveland Metropolitan District, with its one-and-a-quarter million inhabitants. Here great quantities of stock are utilized by the foreign population and others for the home manufacture of wine, by the housewife for eating, sweet juice and jelly purposes, and by the nineteen bonded wineries. The other urban centers of northern Ohio, such as Sandusky, Toledo, Lorain, Ashtabula, Akron, and Youngstown, also consume important amounts. In fact nearly every city of the state receives some of its supplies from the domestic growers.

This nearness of the producers to the markets explains why practically the entire Ohio crop moves to market by motor truck (Table III). It also helps to explain the large proportion of direct to manufacturer and direct to consumer sales in the marketing of the Ohio crop.

The bonded wineries and certain of the juice presses usually satisfy their requirements by purchases from near-by growers. Such purchases are often contracted for before the picking season begins, the winery agreeing to take all or part of the grower's crop at a stipulated price, or in some cases, at the market price prevailing on the day of delivery.

Many consumers, especially those requiring large quantities of grapes for the home manufacture of wine, commonly drive to the vineyards to inspect the grapes and buy. Such buyers either take delivery at the vineyards, or order the grapes delivered to their home or to

TABLE III

GRAPES—CARLOT SHIPMENTS[1]

States	*1925*	*1926*	*1927*	*1928*	*1929*	*1930*	*1931*	*1932*	*1933*[2]
California	76,066	64,327	75,925	73,157	59,205	65,185	39,777	42,239	29,038
Michigan	398	3,081	2,023	1,571	1,746	1,620	528	892	579
New York	3,763	7,242	3,050	3,750	2,541	2,049	4,240	1,670	1,128
Ohio	19	110	5	14	17	29	24	18	26
Pennsylvania	589	1,350	689	1,076	879	809	1,290	613	421
Arkansas	394	1,170	108	998	510	322	313	233	190
Missouri	166	686	108	415	225	316	329	170	111
Iowa	50	176	196	234	369	226	185	203	118
Other States	433	448	573	553	610	358	260	233	156
Total	81,878	78,590	82,677	81,768	66,102	70,915	46,946	46,271	31,767

[1] Includes boat shipments reduced to carlot equivalents, but not movement by motor truck—U. S. D. A., Bureau of Agricultural Economics.

[2] Preliminary.

Because of the local nature of the markets, the motor truck moves practically the entire Ohio crop. Of the eighteen carlot shipments made in 1932, six came from Middle Bass Island and five from South Bass Island. In these cases there was no choice other than shipping by boat. Of the remaining cars, five were shipped from Unionville, and one each from Sandusky and Vermillion. Eleven of the eighteen carloads went to Detroit, and five to Philadelphia.

TABLE IV

CARLOT UNLOADS OF GRAPES BY STATES OF ORIGIN IN CERTAIN OHIO CITIES DURING 1933[1]

City	*California*	*New York*	*Pennsylvania*	*Arkansas*	*Oklahoma*	*Missouri*	*Imports Argentina*	*Total*
Akron	60	1						61
Cincinnati	314	3	3	1	1			322
Cleveland	405	15	1	1		1	5	428
Columbus	87	2						89
Dayton	5							5
Toledo	57				1			58
Youngstown	133	1						134

[1] U. S. D. A., Bureau of Agricultural Economics.
In addition to rail shipments, many grapes are trucked into Ohio from Pennsylvania, New York, and Michigan.

a juice press. In other cases the vineyard owner trucks his grapes to the city, where he disposes of them to the consumer at farmers' markets or by peddling. Similarly, these methods are often used in selling retailers. As a result, jobbers, commission houses, wholesalers, and other middlemen do not take as important a part in the marketing of Ohio grapes as they do in the marketing of the crops of the other leading grape states.

The same is true of coöperative associations. With headquarters at Unionville, Lake County, the "Western Reserve Farmers Coöperative Association" is the only one in Ohio which has the handling and sale of grapes as its sole activity. Its members are largely from Lake and Ashtabula Counties, but they probably do not control more than one-quarter of the vineyard acreage of these counties.

Despite their production within short trucking distances of important markets, Ohio grapes encounter strong competition in these markets (Table IV). Since California is the most important out-state source of supply, the price received for the Ohio crop is normally influenced most by the price asked for California grapes. This price in effect establishes an upper limit beyond which the price of Ohio grapes cannot go, even in short crop years.

Not all of the grapes received from California compete directly with the Ohio crop, however. With a marketing season extending from July 1st, through November, the California grapes are available on the markets both before the Ohio crop is harvested, and after it is gone. Again, certain consumers, particularly Italians, demand considerable amounts of *vinifera* grapes, regardless of price. But many consumers have no special preference, and will use either California or eastern grapes, depending on which is the cheaper. Consequently, although lower production costs and the desirable nature of the fruit favor the California grape, the cost of its transportation to eastern markets serves as an important check on its competitive ability. Since 1930, unloads of California grapes in Ohio have decreased considerably because local grapes could often be bought for less than the freight charges of $34.60 per ton on California grapes. This decrease has also been due to the decreased demand accompanying the depression, and more recently it reflects the fact that large quantities of grapes which were shipped fresh during the prohibition years are now being manufactured into wine in California.

Within the price limit established by grapes from California, the Ohio price is in turn affected both by production in other eastern states and by the size of the local crop, more particularly the latter. Thus, a light crop within the state usually results in higher prices, which, however, would no doubt be higher still but for the influence of pro-

duction in California and in the other American grape-producing states (Figure 4).

Competition of grapes from New York, Michigan, and Pennsylvania is much greater than indicated by carlot unloads from these states, since considerable quantities of grapes from these states are also shipped into Ohio by motor truck. Although transportation costs favor New York and Pennsylvania grapes in northeastern Ohio, Michigan grapes enjoy an advantage for most of the rest of the state. Competition from the Michigan crop is strongest early in the season, chiefly in the table grape markets. Competition from New York and Pennsylvania grapes is greatest during the latter part of the season, especially in the bulk markets.

FIGURE 12.—Cask-Villa, a novel group of cottages on Lake Erie constructed from white oak casks formerly used to age wine in a large Cleveland winery. Once filled with wines pressed from Ohio grapes, these casks are now rented by vacationists for $15.00 per week.

OUTLOOK

The ultimate benefits, if any, of "Repeal" to the grape industry of Ohio are not yet clear, but the near term outlook in the Sandusky and Island District appears promising. Since the production of Catawba and other native wine grapes in this area is second only to that of the Finger Lakes District of New York, it is one of the leading centers for production of quality wines outside of California.

Eighteen of the thirty-nine wineries in operation in Ohio immediately prior to the enactment of the 18th Amendment, were in this district. As already indicated, the closing of most of these during the prohibition years destroyed the best market for the grapes raised in the vicinity, and resulted in neglect and abandonment of many of the vineyards. Five wineries only were operating in and near Sandusky at the time of repeal. Seven others have since resumed operation and additional ones contemplate operation in the future. Some of these are juice presses and need only bonding. Thus, the re-created demand for quality wine grapes, combined with the curtailed supply, will no doubt be reflected in high prices, and possibly a shortage of such grapes over the next few years. As a result, considerable reclamation of neglected vineyards and new plantings of Catawba are likely to be undertaken. Although proposed plantings are numerous, the lack of capital is at present a limiting factor.

The outlook in other parts of the Ohio grape belt, where the Concord is the principal variety grown, is uncertain. Indications are that the home manufacture of wine will continue to be extensive, however, since the consumption of many families of foreign extraction is too large for them to pay the present minimum price of around $1.50 per gallon for legally manufactured wines.

In addition some Concords, no one knows how many, will be utilized by the sixty-four, or more, wineries authorized to operate in Ohio. It is possible therefore, that the total demand for Concords will not decrease greatly, particularly if economic conditions are materially improved, thus improving the curtailed purchasing power of the middle and lower classes.

PACIFIC COAST OIL AND NATURAL GAS

Willis H. Miller

PETROLEUM and natural gas are by far the major fuels used on the Pacific Coast. The wood burned by lumber industries in the Northwest, and the some 2,500,000 tons of coal mined annually in Washington are of comparatively little importance (Figure 1). All of the significant oil and gas fields on the West Coast are located either in the Southern California coastal region or in the southwestern part of the San Joaquin Valley. New producing areas may be found adjacent to present fields, but it seems unlikely that any large supplies either of petroleum or natural gas will be developed in other parts of California, Oregon, or Washington.

Production and Consumption.—Until the recent depression, the production both of petroleum and natural gas in California showed remarkable increases following the discovery of new oil and gas fields during the early part of the past decade (Table I). In 1929, the year of maximum output, 293,000,000 barrels of petroleum and 558,000,000,000 cubic feet of natural gas were produced.

TABLE I

PRODUCTION AND USE OF CALIFORNIA OIL AND NATURAL GAS[1]

Year	*Petroleum (000 bbls.)*	*Natural Gas (000,000 c.f.)*		
	Produced and Consumed	*Produced*	*Consumed*	*Wasted*
1921	112,000	82,000	72,000	10,000
1922	138,000	121,000	94,000	27,000
1923	263,000	319,000	129,000	190,000
1924	229,000	249,000	121,000	127,000
1925	232,000	237,000	145,000	91,000
1926	225,000	274,000	189,000	85,000
1927	231,000	293,000	219,000	74,000
1928	232,000	317,000	239,000	78,000
1929	293,000	558,000	309,000	248,000
1930	227,000	545,000	324,000	221,000
1931	189,000	385,000	317,000	68,000
1932	178,000	277,000	259,000	18,000
1933	173,000	270,000	258,000	12,000

[1] Data from Bureau of Mines, *Mineral Resources of the United States*, and figures compiled by Claude C. Brown, California Railroad Commission, published in *Report V* of the Federal Oil Conservation Board, 1932.

Local systems of land tenure seem to have affected the intensity of this

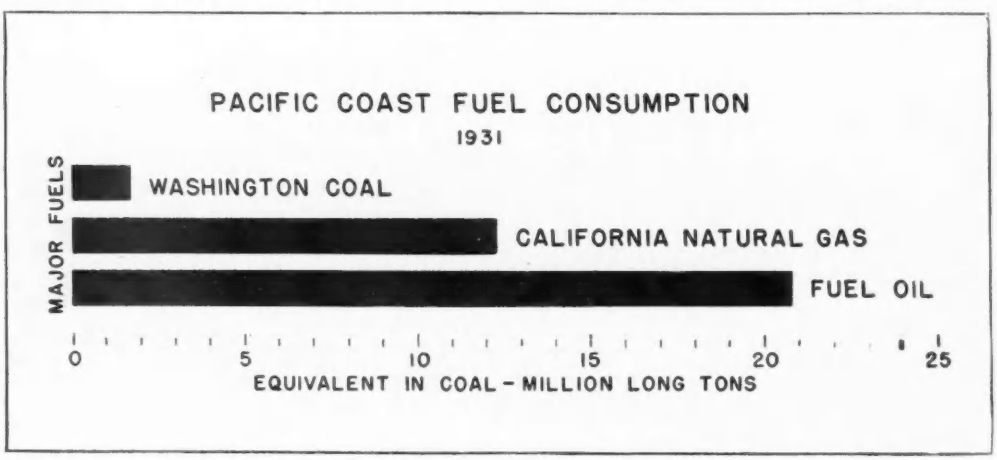

FIGURE 1.—The major fuels consumed on the Pacific Coast during 1931. To allow direct comparison, each fuel is represented by its equivalent in million long tons of coal. It has been calculated that one long ton of coal, 25,000 cubic feet of natural gas, and four barrels of fuel oil, each have a heat value of roughly 26 million B.t.u. (National Industrial Conference Board, *Oil Conservation and Fuel Oil Supply*, New York, 1930, pp. 151–152). This ratio is here adopted as a convenient method for determining the relative importance of unlike fuels.

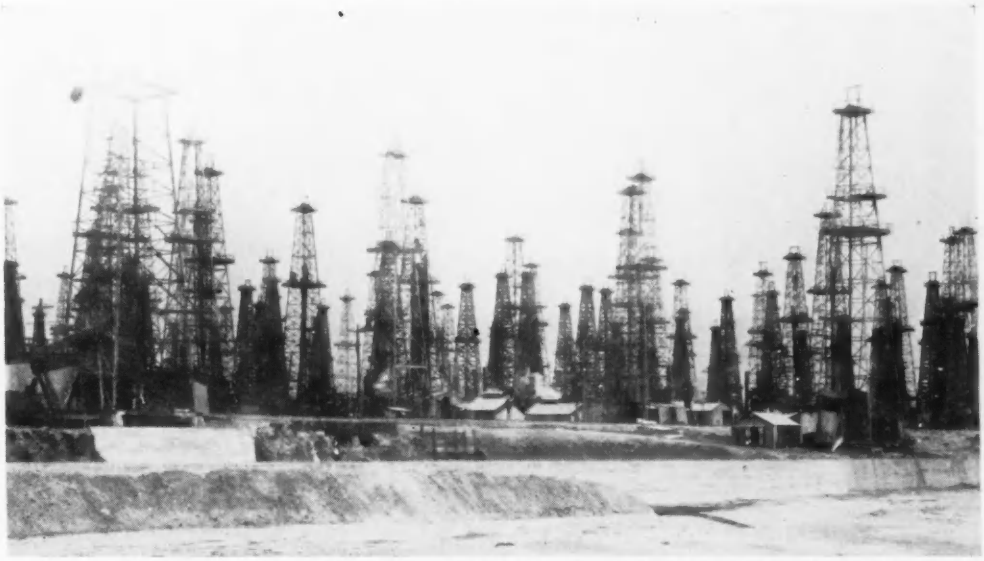

FIGURE 2.—An extreme example of "town lot" drilling in the Huntington Beach oil and gas field, Orange County, California. It is reported that midget derricks have been built on plots of ground too small to accommodate standard equipment. The inefficiency of such development is self-evident. (Courtesy of U. S. Bureau of Mines.)

frenzied exploitation. Rich oil sands were found under parts of the Los Angeles Basin, a populous region characterized by small land holdings. Fear that neighbors might get more than their share of the oil in the common pool here led to the needless duplication of expensive wells and producing equipment (Figure 2). Huge ranches in the sparsely settled southern San Joaquin Valley, by contrast, frequently made it possible for producers to control areas large enough to permit orderly development (Figure 3).

All of the oil produced has been consumed either in the domestic or the foreign markets. Unfortunately, however, unbelievable quantities of gas—as much as 248,000,000,000 c.f. in a single year—have been blown into the air and wasted. Increased use of gas as a fuel, enforcement of new gas conservation laws, and increased vigilance on the part of operators recently have reduced this wastage to about 12,000,000,000 cubic feet (Figure 4).

Regional Markets.—As has been suggested above, not all of the petroleum produced in California has been used on the Pacific Coast. In 1931, a total of 189,000,000 barrels of crude oil were produced, and 58,000,000 barrels of refined and crude oils were shipped from West Coast ports to foreign countries and to the Atlantic coast of the United States.[1] During that year, therefore, about 131,000,000 barrels of petroleum and its products apparently were used in California, Oregon, Washington, and adjacent states. Exports of California oil consist chiefly of fuel oil, gasoline, and kerosene to Japan, China, Chile, Panama, and other countries of the fuel-poor Pacific Basin, and of gasoline to northwestern Europe. Most intercoastal shipments, largely gasoline, go to ports on the Atlantic Seaboard between Portland and Norfolk.

[1] In this paper the year 1931 is used as a sample because (a) that is the most recent year for which complete statistics are available, and (b) conditions in that year indicate recent trends without giving undue emphasis to the depression.

Fuel oil, the Pacific Coast's chief source of heat and power, is of particular interest. During 1931, 95,000,000 barrels of fuel oil were produced by California refineries, and 83,000,000 barrels were consumed in California, Oregon, and Washington. In earlier years of larger production and greater economic activity, more fuel oil was produced and consumed locally or shipped to overseas markets.

No pipe lines carry natural gas outside of California from fields located within that state. Virtually all of the natural gas produced on the Pacific Coast, therefore, is either used or wasted in the state of California.

Pacific Coast Consumers.—During 1931, as in other years, steamships and railroads together used about 60 per cent of the 83,000,000 barrels of fuel oil consumed on the Pacific Coast, and were by far the leading markets for this commodity (Table II). Industries as a group took over 8,000,000 barrels of fuel oil, the navy together with army transports required almost 6,000,000 barrels, oil companies burned more than 4,000,000 barrels, while commercial heating and gas and electric plants each accounted for some 3,500,000 barrels.

Industries consumed 251 billion of the 306 billion cubic feet of natural gas used in California during 1931. Of this total, 150 billion feet were used in oil field operations, and 101 billion feet by other industries including 45 billion feet burned by electric power plants. At the accepted ratio—25,000 cubic feet of gas = four barrels of oil = one long ton of coal—it will be seen that the industrial consumption of natural gas in California is the equivalent of 40,000,000 barrels of fuel oil or 10,000,000 tons of coal. In addition to the great industrial demand, some 46 billion feet of gas were used for domestic heating and about 8 billion feet for commercial heating.

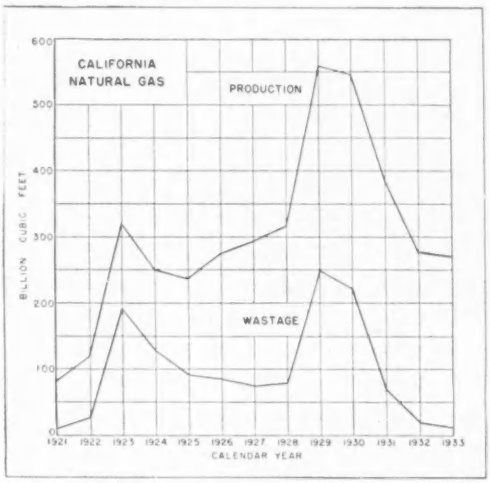

FIGURE 4.—The production and wastage of California natural gas—consumption is indicated by the difference between these curves. Production increased sharply following the discovery of new oil and gas fields in 1922, but subsequently declined due to shut-downs caused by the depression. Completion of the Kettleman Hills-San Francisco pipe line largely accounts for the rise in consumption of natural gas after 1928. Wastage, formerly a conspicuous problem, now seems to be well under control.

FIGURE 3.—Oil wells in the Kern River district of the southern San Joaquin Valley, California. Regular spacing of derricks about 250 feet apart indicates orderly development, but it is probable that even fewer wells would be adequate. (Courtesy of U. S. Bureau of Mines.)

TABLE II

CONSUMPTION OF FUEL OIL BY STATES AND BY USES ON THE PACIFIC COAST DURING 1931 [1]

Consumer	*Fuel Oil Used 1931 (000 bbls.)*			
	California	*Oregon*	*Washington*	*Pacific Coast*
Steamships	25,300	400	2,400	28,100
Railroads	19,400	2,300	1,700	23,400
Industries	5,800	1,000	1,600	8,400
Navy and transports	5,400	200	100	5,700
Oil companies	4,300	....	100	4,400
Commercial heating	2,700	400	500	3,600
Gas and electric plants	1,800	1,700	200	3,600
Domestic heating	200	100	200	500
Miscellaneous	3,500	500	1,300	5,300
Total	68,300	6,600	8,000	82,900

[1] Data from Bureau of Mines, *Mineral Market Reports*, No. M.M.S. 154, Nov. 16, 1932.

Prices.—Prices of oil, and, to a lesser degree, of gas are subject to fluctuations caused in part by variations in production, local demand, and world market conditions. In 1931, fuel oil prices at Los Angeles and San Francisco ranged from 60 to 88 cents per barrel f.o.b. refinery, depending on the quality (Figure 5). Prices at San Francisco are about 4 cents per barrel higher than at Los Angeles due to the longer pipe line haul from San Joaquin Valley fields. At the present time, fuel oil in California is sold for from 80 to 95 cents per barrel f.o.b. refinery. Cost to the ultimate consumers depends largely on their proximity to active refineries and producing fields. For example, transportation of fuel oil from California to Oregon and Washington has ranged from 15 to 25 cents per barrel.

The price of natural gas varies considerably with the class of service for which it is sold. In 1931, industries other than oil producers paid an average of 15.7 cents per thousand feet, gas for commercial heating cost 68 cents per thousand, and gas for domestic heating cost 96 cents per thousand.

Estimated Reserves.—Several estimates have been made concerning the reserves of petroleum in California (Table III). Although the most recent calculations show a larger quantity of petroleum available for future use than

FIGURE 5.—Part of the Standard Oil Company refinery at Richmond, California. Numerous large oil refineries are located in Metropolitan Los Angeles and around San Francisco Bay. Crude Petroleum is brought in both by pipe lines and by tankers from producing areas in various parts of Southern California. (Courtesy of U. S. Bureau of Mines.)

do earlier estimates, it is clearly evident that the reserve supply is comparatively small (Figure 6). At the current rate of production—about 225,000,000 barrels per annum—the present known reserves available by present methods of pumping would be exhausted in some 20 years. However, much oil still remaining in the sands could be recovered by flooding, by mining, or by some other expensive process.

TABLE III

VARIOUS ESTIMATES OF PETROLEUM RESERVES IN CALIFORNIA OIL FIELDS

Year	*Estimated Reserves (000 bbls.)*	*Source*
1919	2,300,000	Bureau of Mines
1925	2,140,000	American Petroleum Institute
1934	4,290,000	L. P. Stockman [1]
1934	5,420,000	Geological Survey

[1] Stockman, L. P., *Future of California as to Reserves and Markets, Oil and Gas Journal*, September 20, 1934.

Agencies such as the United States Geological Survey, or the Bureau of Mines have made no estimates of natural gas reserves in California. Most California natural gas is produced as a by-product in oil fields. This condition increases the normally great difficulty of arriving at even an approximate estimate of gas reserves. At the present time more gas is produced than is consumed, but gas is a notoriously ephemeral resource. It seems unlikely that vast quantities of natural gas will be available for many more years.

Future Problems.—At some time within a relatively few years it seems inevitable that California's production of oil and gas will be too small to satisfy the Pacific Coast demand for fuel. In this event, either oil must be imported from other regions or substitutes such as coal and hydro-electricity must be further developed. Because the estimated petroleum resources of California constitute about 30 per cent of the total national reserves, it seems unlikely that, when the California fields are seriously depleted, there should be any considerable surplus in other parts of the country for export to the Pacific Coast. Probably, therefore, any imported oil would have to come from the Dutch East Indies or some other distant source of supply. A long ocean haul adds from 50 cents to one dollar to the cost of every barrel of fuel oil. At current prices this addition would about double the cost of fuel oil on the West Coast.

Any such increase in the cost of fuel oil obviously would stimulate coal mining in Washington (where reserves are estimated at about 65 billion tons), Alaska, Utah, New Mexico, and in other areas close enough to ship coal to population centers on the Pacific Coast. Hydro-electric sites now considered economically inadvisable also would seem desirable and necessary. In the interests of conservation and long-range regional planning, it appears necessary to consider the problems arising from possible depletion of California's resources of oil and gas, to study plans for postponing this impending disaster, and to investigate alternative sources of fuel and power which might be substituted for oil and gas.

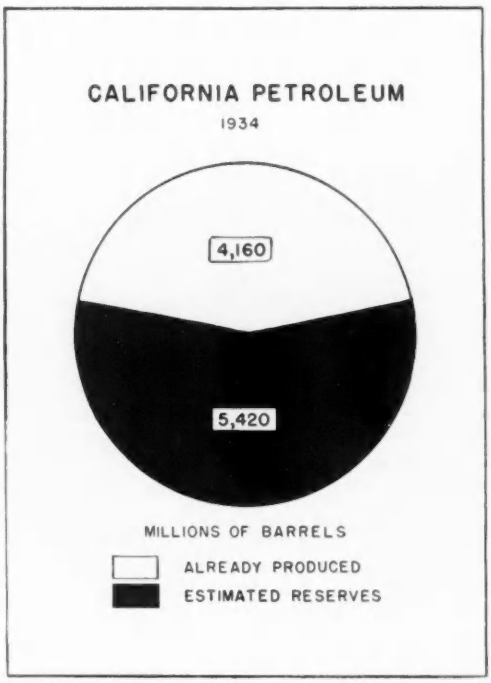

FIGURE 6.—Almost half of California's known resources of petroleum have been produced and consumed. Proven reserves represent a normal output for only about twenty more years. Clearly, then, the Pacific Coast faces early depletion of its major fuel supply unless great new oil reserves are located within the next two decades.

TOPOGRAPHY AND TOWNS OF THE CAROLINA PIEDMONT

S. T. Emory

ANY ONE examining a map of the southeastern states is struck by the number of small cities and large towns along the Piedmont Plateau of North and South Carolina. The well-known row of cities along the Fall Line can hardly be attributed to the Piedmont, since both their sites and their reasons for existence belong as much to the Coastal Plain as to the Piedmont Plateau. The central Piedmont, however, shows as definite an alignment of cities and towns along the main line of the Southern Railway as that along the Fall Line, and closer study of the map brings out several cross-alignments along east-west railways. It would seem that these cities are born of the railroad; but practically all of the larger towns have been in existence for a hundred and fifty or two hundred years, and thus antedate the railway. Obviously, these towns were set in some fundamental pattern, to have not only survived but grown throughout radical changes in transportation, increasing density of population, and shifting occupations in the countryside.

The Physiographic Base Pattern

Study of a physical map shows that the Carolina Piedmont towns are set into a transportation pattern so well adjusted to the topography of the area as to serve equally well for trail, plank road, railway, or motor highway; further, a pattern which is reversible, serving equally well for east-west or north-south traffic flow.

The Central Piedmont Highway

The alignment of towns along the mainline of the Southern Railway is on a natural highway between the northeastern and southeastern states. The eastern margin of the Piedmont is deeply dissected by a series of southeast-flowing rivers spaced rather evenly some twenty to thirty miles apart. Its western margin is invaded by a number of outlying hills and spurs of the Blue Ridge. Along the central Piedmont, however, lies a natural pathway which avoids the highland spurs on the west, passes around the headwaters of several of the shorter rivers, and crosses the longer rivers where their valleys are neither very broad nor very deep. Along this natural highway ran an important Indian trail, here passed many of the Scotch-Irish and German immigrants drifting down from the north, and here early settlers built short roads which were soon consolidated into a continuous highway.

East-West Traffic Routes

The main traffic flow of the early Piedmont was not, however, along this natural north-south route. Land transport was arduous and expensive and was used, particularly for freight, only where water transportation was not available. The Piedmont settlers, therefore, took their freight to the nearest navigable water, using their rocky streams to float bateaux at time of flood, but usually going by land to the head of navigation at or below the Fall Line on the nearest river. For this journey the divides between the rivers offered the easiest route. There were few creek crossings to be made, there was little danger of flood, and roads drained and dried rapidly along the crests of the divides. Thus, along each inter-stream

divide, projecting as a tongue of higher land toward the Fall Line, ran a pioneer trail. Continuing across the Piedmont, these roads entered the valleys which the larger streams had carved through the foothills to the Blue Ridge and gathered there thin streams of traffic which trickled down by devious trails from the highlands beyond. These were the main roads of early days. They were of approximately equal importance, for there is no easy pass through the Carolina mountains to the west and no outstanding natural harbor along the Carolina coast to cause a concentration of traffic along any one route.

EARLY PIEDMONT TOWNS

Thus a grid of early roads was established along natural routes, with the main east-west roads, some twenty to thirty miles apart, running out of the western valleys, across the central Piedmont, and down the inter-stream divides to the Coastal Plain; and with a secondary north-south road cutting across them along the middle of the central Piedmont, serving as a feeder to the east-west roads and as a cut-off for hurrying traffic to or from the north. At each intersection of north-south and east-west roads grew up a collecting and distributing center for the adjacent countryside—a trading post, a general store, and by the time of the Revolution, a village. Each inter-stream divide had one or more settlements of this sort at its base in the central Piedmont, and these villages were aligned along the secondary north-south route. Greensboro, Lexington, Salisbury, Concord, Charlotte, Spartanburg, and Greenville formed an alignment of small regional centers spaced some twenty to thirty miles apart along the natural pathway of the central Piedmont.

Twenty to thirty miles seems to have been the maximum diameter of the trade area of these villages. Ten or fifteen miles into town and ten or fifteen miles back is a long shopping journey with horse-drawn vehicles. The settlements along the central Piedmont could not serve the entire area. Other regional centers, usually smaller, developed at intervals of twenty-five miles or so along the east-west roads. Wilkesboro, Salem (now Winston-Salem), Graham, and Hillsboro, with Greensboro on the central Piedmont alignment, formed a chain of villages reaching from the Blue Ridge along the northernmost stream divide to the Fall Line beyond Raleigh. Similar alignments marked each east-west road. These villages, regional centers for agricultural areas of about equal size and productiveness, became county seats and grew slowly with the development of their tributary regions. They collected goods for shipment by wagon to the river ports of the Coastal Plain and sold incoming freight at retail or distributed it by wagon to outlying country stores. Stores and blacksmith and wheelwright shops developed; lawyers and doctors tended to live at these foci of community life; and numerous academies and small colleges attested the concentration there of regional culture. The settlements of the central Piedmont alignment tended to grow more rapidly, particularly those on the longer east-west roads, for they enjoyed the handling of some through traffic. The growth of all was very slow, however, and the largest was a mere village as late as 1840.

THE COMING OF THE RAILWAY

When the railway came to America, Piedmont leaders saw at once their need of the new service and pressed for state aid in building a railway north and south along the central Piedmont where it would reach the largest possible Piedmont area, to join a similar road in Vir-

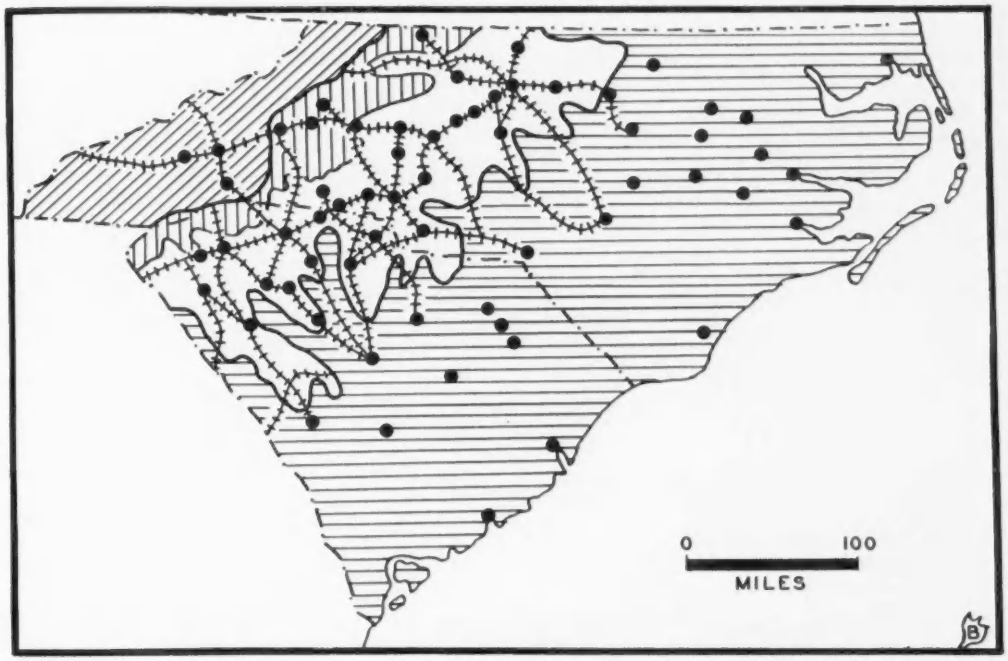

FIGURE 1.—Horizontal lines, area under 500′; unshaded, area between 500′ and 1,000′; vertical lines, area between 1,000′ and 2,000′; oblique lines, area over 2,000′. All towns of more than 4,500 population (U. S. Census, 1930) shown. North and South Carolina. The main line of the Southern Railway crosses the central Piedmont from northeast to southwest, while each projection of higher land into the eastern lowlands carries an east-west railway line. Fourteen towns of over 4,500 population are aligned along the main line of the Southern Railway, and cross-alignments of towns can be traced along the projecting highlands. (Approximate contours after Goode. Secondary north-south Piedmont railways not shown. Eastern railways shown only where significant in developing Piedmont towns.)

ginia. The Coastal Plain wished the railway first to serve as a portage road to connect its several navigable streams, then to strike west from its river towns and bring down to them the trade of the Piedmont. An inter-regional contest followed, the outcome of which was a grid of railways, publicly and privately built, which paralleled existing roads along the natural transportation pattern of the Piedmont. Along each inter-stream divide ran a railway from deep water to the Blue Ridge, and across these east-west lines from town to town of the central Piedmont alignment ran north-south railroads which were eventually consolidated into the main line of the Southern Railway. Because the railways paralleled the dirt roads, intersections were practically the same, and because local conveyance was still horse-drawn, each regional center continued to serve about the same area as before. The Piedmont towns were stimulated, rather than disturbed, by the development of railroads in the region.

REVERSAL OF TRAFFIC FLOW

As improved land transportation began to supplant water transportation even on long hauls, the direction of Piedmont traffic was reversed. The north-south railway of the central Piedmont became the main line, while erstwhile main lines east and west became feeders to it. Although the shift checked the growth of Coastal Plain port towns, it made little difference in the Piedmont, for local centers of collection and distribution remained the

same, regardless of the origin or destination of freight. The old Piedmont towns continued to develop, but very slowly still. The largest of them had only 11,557 population in 1890.

INDUSTRY AND HYDRO-ELECTRIC POWER IN THE PIEDMONT

When, about 1890, the extraordinary industrial development of the Southeast began, the entire Piedmont offered a supply of cheap labor. The small towns along the Southern Railway offered concentration of labor, direct railway

FIGURE 2.—Business section of Greenville, South Carolina. A pleasant, modern city of thirty thousand population along the main line of the Southern Railway. (Courtesy of W. B. Coxe, Photographer, Greenville, S. C.)

transportation north, south, east, and west, and certain urban advantages such as banks and professional service. The flanking town offered the same advantages, except that transportation north and south was not so direct. Hydro-electric power, developing throughout the Piedmont concurrently with industry and increasingly mobile as improvements were made in its transmission, sought markets. Markets were to be found in concentrations of population and industry; so power lines, striding across country on their steel towers and relatively independent of topography, tended to parallel the roads and railways to reach the towns they connected and the cotton mills, furniture factories, and tobacco factories developing in or near them.

The cotton mills, to avoid city taxes and regulations and for better control over their labor, tended to locate along railways just outside the towns and to develop their own mill villages, with company stores, recreation centers, schools, and churches. However, these adjacent mill villages brought trade to the towns and they tended to be taken into the towns eventually. The Piedmont towns increased their population very rapidly from 1890 to 1930, all showing steady growth and several multiplying themselves by ten during this period. Though several of the older towns grew more rapidly than their neighbors, the tendency was still toward development of alignments of towns rather than one great industrial city. For industry as for commerce there was no one outstanding city location. Growth was more vigorous, on the whole, along the main line of the Southern Railway, five of the seven Piedmont cities of over twenty-five thousand lying along this north-south line. The two great tobacco towns, Durham and Winston-Salem, which developed along the northernmost cross-alignment, seem, in the absence of any detailed study, to owe their development to the genius of a few local individuals, rather than to any particular advantages of location. Thus, on the whole, industry and waterpower graved still deeper the urban pattern set by pioneer roads.

MOTOR HIGHWAYS

Obviously, motor roads, designed to connect population centers with each other by the easiest and most direct

routes and to connect regional centers with their tributary areas, would tend to follow established transportation lines, particularly if those lines were based on topographic advantages. The magnificent concrete highways built in the Piedmont in the past decade parallel the railways and the old dirt roads. Each of the old Piedmont towns is now a highway center, with important automobile passenger traffic and heavy and increasingly important truck transportation of freight.

The automobile is changing the relationship of the old regional centers to their tributary areas, for ten miles into town and ten miles back is no longer the limit of a day's shopping tour. The change is still in progress and seems to be favorable to the larger towns, though they report that the bulk of their retail trade is still with their old trade areas. The truck has changed wholesale distribution to some extent, and again the shift seems to favor the larger towns. There seems to be no danger of obliteration of any function of any of the old regional centers, however. Rather, a selective process appears to be going on by which the larger towns, in addition to supplying everyday needs of their old trade areas, tend to meet unusual or luxury requirements of a larger area. Loss of certain retail and wholesale business in the smaller towns is at least partially compensated for by more intimate connection with the local trade area and by retail sales of automobiles, gasoline, tires, etc.

FIGURE 3.—Charlotte, North Carolina, the largest city of the Carolina Piedmont. The commercial center in the foreground, with railway terminals beyond. (Courtesy of Charlotte Chamber of Commerce.)

PIEDMONT ALIGNMENTS TODAY

The alignment of population in the Carolina Piedmont along natural traffic routes is even more pronounced than appears from the map, for the map shows only the nodes of population lines. Main roads are built up closely for miles beyond the towns—closely, that is, for an essentially rural area. The old traffic grid is no longer marked only at intervals. Roads, railways, and power lines parallel to each other along the topographic lines of least resistance are bordered by more or less continuous rows of residences and filling stations. Large towns occur at intervals of twenty-five miles or so, with small mill villages at intervals of a few miles along

the roads between them. A traveller along Piedmont roads, particularly along the central Piedmont, is seldom out of sight of the characteristic tall water tanks which mark the presence of a mill or a town.

THE TYPICAL PIEDMONT TOWN

The old Piedmont towns of the Carolinas look new. They are new, in fact, for most of their growth has come in the past three decades and most of the older buildings have been outgrown, or outmoded, and demolished. They are not particularly southern in appearance or in tempo. They are busy, hustling towns, with the typical American skyscraper at the center of town, the usual chain stores, the usual one high-grade store, the usual hospitals and apartment houses, ornate banks, and splendid schools and other public buildings. White residence sections are full of well-kept new homes of the current fashion. High-grade suburban developments show the usual winding streets and elaborate landscaping, the usual Elizabethan, Spanish, and Georgian mansions, to be found in any similar town of the Northeast or the Middle West—and no higher proportion of high-pillared southern homes. The Negro sections are southern, of course, though well-to-do Negro streets are indistinguishable from equivalent white streets. The cotton mill villages are distinctive, perhaps, but they resemble workmen's residence areas of cities in other regions. These cities, on the pulsing arteries of a busy and developing region, are too vital to retain an antebellum mold. They are typical of eastern towns on natural traffic ways.

To one expecting the Carolina Piedmont towns to be either cotton mill towns, tobacco towns, or furniture towns, the activities of any one of them are surprisingly varied. They are traditionally regional centers; and they show this function in their many retail stores, their numerous wholesale houses, their several hospitals, their one to half-a-dozen colleges for white and Negro, their professional buildings thickly hung with lawyers' and doctors' signs, and by their not-infrequent home offices of large insurance companies. They are transportation centers; and they show it by large railway stations and freight yards, bus stations, and terminals of trucking companies. They are industrial centers and by no means confined to any one manufacture, though cotton mills predominate. Winston-Salem, Durham, and Reidsville are usually thought of as tobacco towns, High Point and Thomasville as furniture towns, while the others are usually grouped as cotton mill towns. Actually, there are important cotton mills in all these towns, and there is a host of lesser manufactures as well. Silk (rayon) mills, overall factories, flour and cotton seed mills, bakeries, bottling plants, lumber yards, foundries, fertilizer and patent medicine factories, brick yards and tile plants, give to these Piedmont towns a much more varied support than is usually supposed.

SUMMARY

Thus a transportation pattern, with a consequent urban pattern, set by pioneer settlers of the Piedmont along topographic lines of least resistance has persisted and become intensified through a century and a half of regional development. It has served for horse-drawn vehicles, for railways, for automobiles; it has served a traffic seeking water transportation and has survived the decline of inland waterways; it has served for a thoroughly agricultural occupance, and it serves equally well the present industrial development. Throughout the American era of big-city building the relative evenness of opportunity at many points of the transportation pattern de-

veloped many small urban centers, rather than one great city. While certain towns have outgrown others and the relative importance of cities has shifted from time to time, the fundamental nature of the transportation pattern has preserved and developed each of the old Piedmont villages. Buttressed as it is today by heavy financial outlay and by the force of long custom, it seems unlikely that the transportation pattern or the urban pattern of the Carolina Piedmont will be seriously disturbed. Present towns should continue to grow with the development of the region, unevenly, perhaps, but in their present locations.

METHODS EMPLOYED BY GEOGRAPHERS IN REGIONAL SURVEYS

G. Donald Hudson

THE study of the relationships between human activities and the natural environment and the regional approach to this study have long since been recognized by the sciences as the particular province of geography. Because he is concerned with these relationships, the geographer has given considerable attention to methods of developing a thorough knowledge and understanding of the occupancy pattern, that is, the landscape expression of the life of an area. Some of these methods have dealt with the portrayal of distributions. Others have dealt with gathering and recording data. The purpose of this paper is to present some of the more recently developed of these two groups of methods.

One method of portraying distributions that has been applied to geographic problems relatively recently is the isopleth map (Figure 1). An isopleth is a line that connects points of equal abundance or density. Thus a U. S. Geological Survey topographic map is an isopleth map of elevations above sea level. The contours are isopleths connecting points of equal elevation above sea level. Isotherms, isobars, and isohyets are isopleths respectively of temperatures, barometric pressure, and rainfall. These isopleths show the gradations and the distribution patterns of the phenomena which they treat. Likewise isopleths can be used to show the gradations and distribution patterns of other phenomena such as, for example, the density of livestock, the distribution of land values, or the percentage of farm land in pasture (Figure 1).

When applied to geographic materials, the isopleth method of portraying distributions becomes intellectualized cartography. The procedure used in constructing such a map requires insight into and an understanding of the interrelated factors that are involved. Also a high degree of cartographic skill is essential to obtaining full geographic values. The procedure includes several well-defined steps. First, unit areas are laid out in map form. They may be political units such as counties (Figure 2), or they may be arbitrary units laid out in the form of a grid (Figure 3). In either case, the desired data are plotted in the center of each unit. This is done on the preliminary assumptions that the nearest approach to average conditions occurs at the center of each unit area, and that deviations from the average will progress outward, meeting deviations that progress outward from similarly placed data in contiguous units. For example, in Figure 1, the percentage of the farm acreage used for pasture in each of the units laid out in Figure 3 was plotted in the center of each unit. A study of data so plotted reveals the maximum and minimum intensities and significant concentrations. Appropriate class intervals can then be adopted. To illustrate, a considerable portion of the area shown in Figure 1 was found to have no pasture land. That gave one grouping of unit areas. A small portion of the area, mostly in the form of narrow ribbons, had from zero to 25 per cent of the farm acreage in pasture. That gave a second grouping of unit areas. Further study of the plotted data showed that adequate results were obtainable by breaking the remaining

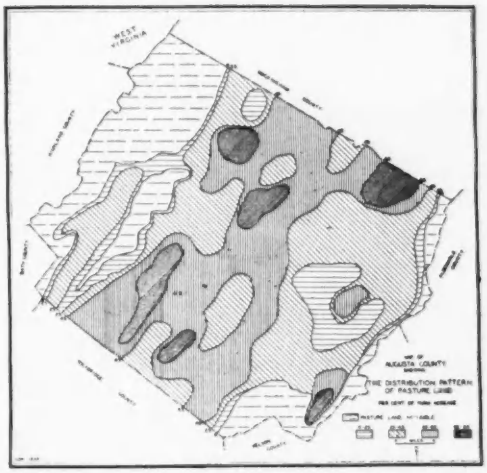

FIGURE 1.—A simple isopleth map showing the distribution and relative areal significance of pasture land in terms of the ratio of pasture land to farm acreage. The unit areas employed were laid off arbitrarily, each unit covering ten square miles. See Figure 3.

area down into three groupings, 25 to 45 per cent, 45 to 65 per cent, and 65 to 85 per cent. After the class intervals are adopted, isopleths are drawn representing their lower and upper limits. In Figure 1, this meant drawing in the isopleths of zero, 25, 45, 65, and 85 per cent. The principle of interpolation is applied to the placing of the isopleths. If, for example, two contiguous units had, respectively, 35 and 55 per cent of the farm acreage in pasture, the isopleth of 45 per cent was drawn equi-distant from the two centrally plotted figures. The strict application of the principle of interpolation is followed unless some known factor, or factors, warrants the deviation of the isopleths. They should not be deviated, however, unless the significance of the factor, or factors, is known equally well for the entire area.

The isopleth map has certain advantages over other cartographic forms. Probably its greatest value lies in the fact that it permits a simple cartographic representation of ratios between two or more phenomena. The relative significance of these phenomena can then be readily observed and studied. Figure 1 is such a map, the relative significance of pasture land being shown by plotting the ratios of pasture land to farm acreages. Another value lies in the fact that isopleths not only present patterns of distribution, but provide a basis for numerical concepts without, for example, the laborious counting of a host of dots.

Modifications of the simple isopleth map include the retention on the final map of the ratios on the basis of which the isopleths were drawn. This modification has the advantage of permitting the same or another investigator, without going back to the original source, to check, alter, or deviate the isopleths if another approach is made or if new data come to hand. It also shows where, within a given class interval, each unit area falls.

Another modification of the simple isopleth map is the retention on the final map of one or more of the absolute values that were used. The Distribution of Land in Harvested Crops is such a map (Figure 2). In this map the isopleths bring out the distribution pattern of the ratios between land from which crops were harvested and farm acreages,—a regional consideration of large significance. The figures plotted in the center of each county show the acres of land in each county that bore harvested crops. If one so desired, other values could be added. For example, the ratio of these two items for each county could be expressed and plotted in the form of a fraction. The advantages of this modification are obvious. The most important probably is that quantitative data are plotted according to their true space relationships, while at the same time, the relationship of one or more unit areas to other unit areas is clearly shown either relatively by the pattern brought out by the iso-

pleths, or directly by the comparison of the absolute data plotted on each unit area.

The desire to know regions, and to understand the life of regions, led the geographer to study the occupancy patterns of regions. The quantitative and qualitative inadequacy of information dealing with these patterns necessitated the development of ways and means of observing and recording their features in the field. The complexities of the occupancy pattern made this problem extremely difficult. The most satisfactory method yet devised and the one most widely used for quantitative field work was devised by a group of Midwestern geographers. This method involves the use of a code written in the form of a fraction (Figure 4). The numerator of the fraction represents the human items in the occupancy pattern. The denominator represents the natural items in the pattern. In other words, each fraction shows the nature and use of the land. By bringing these two sets of items thus into intimate juxtaposition, each fraction represents a single element of the occupancy pattern. When these fractions are plotted on a map, they constitute a cartographic representation of the occupancy pattern. By this means the occupancy pattern can be analyzed and studied. These representations thus become a basis for the development of a thorough knowledge and understanding of the area treated.

Each digit in the numerator and the denominator describes some one item of the cultural and natural landscapes, respectively, or some breakdown thereof. Obviously, any number of digits can be

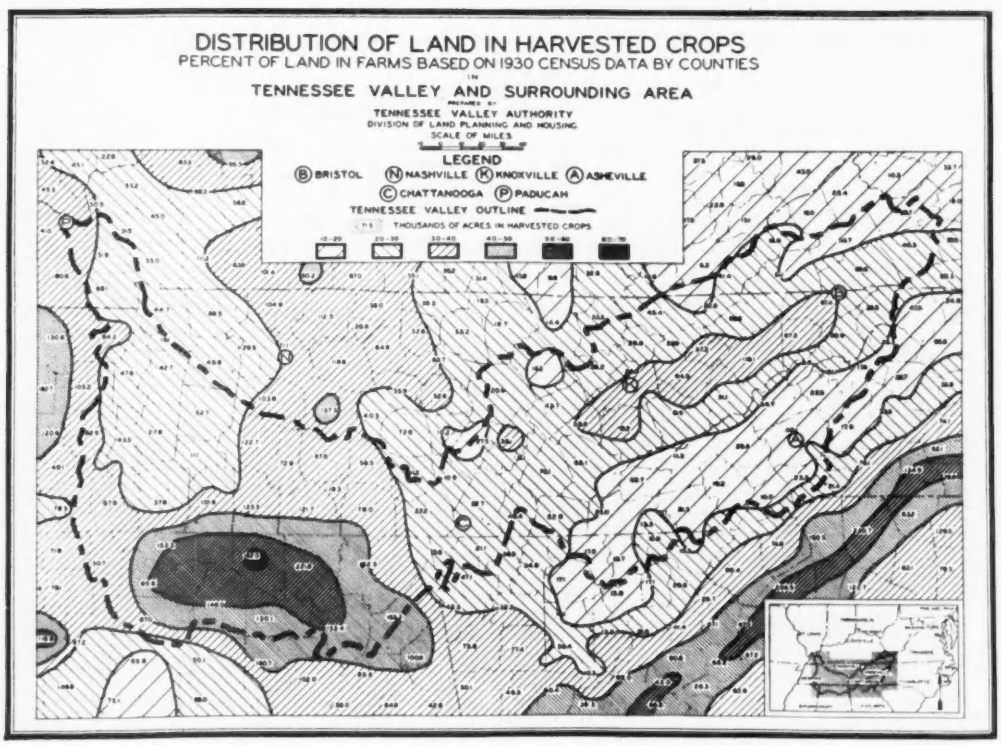

FIGURE 2.—A modified isopleth map, showing the distribution and relative areal significance of land from which crops were harvested in terms of the ratio of this acreage to farm acreage. The unit areas employed were counties. The boundaries of these units and the absolute acreages of harvest land in each unit area were retained.

employed depending upon the amount of detail desired. For example, in Figure 4, the first digit in the denominator represents the slope of the land. The second digit is used to describe drainage conditions. The third digit describes the conditions of erosion. Additional digits may be added to denote soil types or any other natural feature. By the same method, the numerator describes the use of the land, that is, the human or cultural items in the landscape. Again referring to Figure 4, the first digit is used to describe the major land use, namely, crop land, pasture land, idle land, woodland, and so forth. The second digit describes some feature of each of these uses, for example, the kind of crop grown, the nature of the pasture, the cover on the idle land, the type of woodland, and the like. The fractions so formed are noted on the base map being used in the field. As each fraction is noted a line is drawn around the area that is homogeneous in terms of the items being mapped.

Figure 4 shows a portion of a field map after it has been completed. In the upper central part of the map is the fraction 1 a × 5 over 1 3 2. The first digit of the numerator says that the land is cropped. The second digit says the crop is corn. The third digit states that no second or winter cover crop has been planted. The last digit states that the farmer exercises no erosion control. The first digit in the denominator shows that the land has a 0 to 10 per cent slope. The second digit states that the drainage is thorough. The last digit shows that sheet erosion is in progress. The occurrence of the same numerator, 1 a × 5, in contiguous areas shows that the area just noted is a portion of a corn field. In the contiguous areas, however, the nature of the land is not the same as in the area just noted. Therefore, lines are drawn segregating the contiguous portions of the corn field and other denominators are written describing the nature of the land in them. For example, the portion immediately to the right of the area just discussed has the fraction 1 a × 5 over 2 3 2. The difference between these two portions of the same field of corn is observable in the first digit of the denominator. A "2" in that position shows that this portion of the field has a 10 to 20 per cent slope as contrasted to a 0 to 10 per cent slope in the first area.

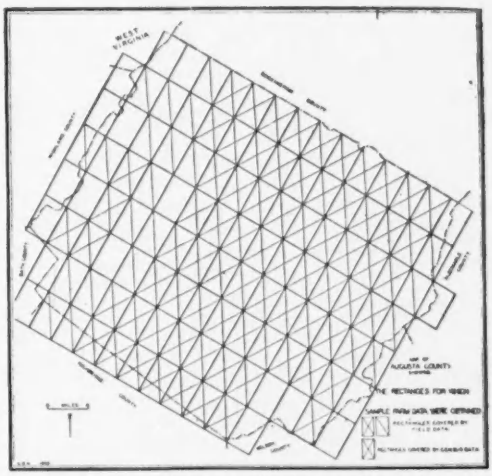

FIGURE 3.—Unit areas laid out arbitrarily. In this case the unit areas are equal in area, each covering ten square miles. Units of this sort whether equal in area, laid out arbitrarily or on a selected basis, can be used for plotting data. These data can represent complete coverage, sample areas, or traverses. See Figures 1 and 4.

After the field maps are completed they are analyzed according to the purposes of the study being made. For instance, the areal distribution of such items as the distribution of erosion classes, or cropped land can be drawn off. Similarly, items can be drawn off in combination as, for example, cropped land and slope classes, or idle land and erosion classes. In this way relationships can be readily observed, measured, analyzed and otherwise treated and studied.

Various base maps, printed or con-

structed in the field, can be used for detailed work. In most rural areas a scale of less than one inch to one thousand feet presents difficulties of insufficient space for notations. Aërial photographs, preferably in the form of mosaics, such as shown in Figure 4, are more satisfactory than ordinary line maps because the field worker is immediately and always oriented in the landscape. Pacing or other forms of measuring distances are greatly reduced if not eliminated.

In some cases the nature of the problems or areas being studied, limitations in time, or other circumstances prevent or make unnecessary the complete coverage of an area by such detailed methods as the fractional code. Various methods have been devised to fit these cases. For example, detailed work is carried on in selected sample areas or in sample areas spaced at regular intervals. Understandings thus obtained can then be projected outward from the sample areas. This method is being applied by the Geography Section of the Tennessee Valley Authority in a study of the Upper Tennessee Valley. In this case a detailed study is being made of a strip four miles wide that extends across the valley at right angles to its axis. The data so obtained perform three functions. First, they provide a quantitative basis for a thorough understanding of the land, its conditions, and its uses in the four-mile-wide cross section. Second, they provide a quantitative basis for a thorough understanding of the area of which the cross section is a sample. The Upper Tennessee Valley consists of a series of longitudinal ridges and minor valleys. Since the cross section lies at right angles to these formations, it in-

FIGURE 4.—A photographic reproduction of a portion of an Aerial Mosaic on which field data have been plotted. The scale of this mosaic is one inch to 1,000 feet. Considerable detail that appeared on the original mosaic has been lost in the processes of reproduction.

cludes samples of each. The adequacy of these samples will be tested by extending traverses up and down the valleys roughly at right angles to the cross section and at intervals parallel to the cross section. During the process of testing, these traverses will reveal areas not represented in the samples and will thus indicate where and to what areal extent additional complete sample studies must be made. And third, the data from the cross section provide a means, through statistical analysis, of determining beforehand at what intervals parallel traverses have to be run to attain desirable degrees of accuracy, that is, every fourth mile, half mile, mile, or some other unit of distance.

The combination of complete coverage and traverses represents one of the methods devised for rapid quantitative field research. Another is the use of traverses by themselves. These traverses take any lineal form. The three types more commonly used are line traverses, strip traverses, and road traverses. In the first case, field notations are made as the conditions being mapped are severed by a straight line. These lines may be drawn across selected areas or, if desired, they may be laid off parallel to each other at regular intervals forming a gridiron pattern. Again, they may be laid off at right angles to each other forming a grid of squares or rectangles. In the case of strip traverses mapping is done in relatively narrow bands. These bands or strips, like line traverses, are laid off across selected areas, parallel and at regular intervals, or at right angles to each other. Road traverses are made by mapping the frontage of phenomena on highways or by mapping a strip of predetermined width on one or both sides of highways. All or selected highways in an area can be used.

In dealing with traverse data distribution patterns can be obtained only by interpolation. This can be done by extending division lines across unmapped territory from one traverse to another. Another method employs the isopleth. For example, the area being studied can be divided into units. As indicated previously, these can be established political units or units laid out arbitrarily. Traverse data for each unit can be transformed into percentages. That is, if the traverse data for a given unit show that one-tenth of the land in or along the traverse is used for corn, then the corn acreage in that unit is expressed in terms of 10 per cent of the total area of the unit. All units are similarly treated and isopleths drawn in. The ultimate result is a distribution pattern. Such a method employing road traverses and an arbitrary grid was used to obtain the pattern shown on Figure 5. The unit areas employed are shown in Figure 3.

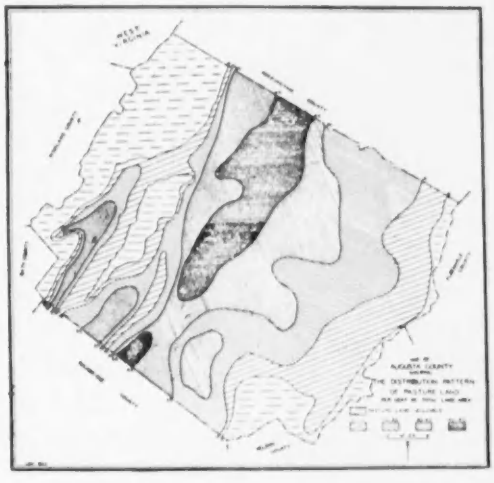

FIGURE 5.—An isopleth map constructed on the basis of data from Road Traverses. This map shows the distribution and relative areal significance of pasture land in terms of the ratio of pasture land to total area. See Figure 3.

The purpose of regional surveys is to provide a basis for the development of a thorough understanding of the human use of regions. Geography makes a major contribution to this purpose by

providing a scientific portrayal of the occupancy pattern. But the contributions of geography to regional understandings do not end here. After the geographic methods presented here have been applied, the data so acquired must be assembled, analyzed, manipulated, tested, measured, and otherwise treated according to the methods and discipline of scientific geography. Within these processes lie other major contributions that geography makes to a thorough understanding of the human use of regions. Probably most of these contributions will prove of service to regional planning.

BOOK REVIEWS

BENGTSON, NELS A., AND VAN ROYEN, WILLEM. *Fundamentals of Economic Geography.* xxviii and 802 pp.; numerous maps, charts, graphs, and illustrations; bibliography and index. Prentice-Hall, New York, 1935. Price, $5.00.

In some respects this book is unique, though in general it follows an orthodox system of presentation of the wealth of fact and principle which it is planned and prepared to provide. It is unique particularly in that, while it is, as the title suggests, chiefly an economic geography, it may be almost as appropriately considered a text in general geography; and in the hands of a competent and intelligent teacher it may readily be adapted to both purposes. An economic geographer would certainly feel that much of the subject matter of the book, though essentially geographic, is by no means relevant to economic geography, however much it may enrich the content of the book. The value of the work is appreciably enhanced by the dual possibilities it offers in college teaching, and while some few may be disappointed that it is so general in its character, there will be many others who will find satisfaction in the ability to economize by making the volume serve two purposes.

It would be tedious to attempt to enumerate the contents of the thirty-one chapters comprising the work; but it is worth while stating that interspersed among the more strictly economic chapters of the book are a goodly number of chapters dealing in a measure with physical geography, or phases of human geography other than economic. The balance of space and emphasis among the chapters, according to the extent and importance of the subjects with which they deal, is admirably sustained throughout the book, and it would be hard to find fault with the factual substance of any chapter. Some of the conclusions which hardly seem warranted, though they are generally accepted, might be questioned in the light of recent research; but after all, a textbook may not be too exploratory or original. Established, rather than controversial, doctrine is generally best for textbooks.

The course of presentation of material starts with the earth, land, and minerals, proceeds to the uses of power and minerals, continues with a regional presentation of world economy and industry based upon climatic criteria, and concludes with the economic significance of the sea, agrarian regions, manufactures and commerce, and the traditional world survey. An excellent list of publications consulted, and a comprehensive, convenient index bring the 800 pages to a close.

On the whole it is a thoroughly usable and sound book, the kind that any department of geography may safely and successfully adopt for use in its classes. It should meet widespread and general approval and sale. It is likely to monopolize its field until some strikingly new or superior book appears. It is bound well, is printed in good clear type on excellent paper, and in every way measures up to the price asked for it; in a way it is a bargain at the price, for no one can fail to profit far beyond his expectations by using the book either as text or reference.

W. ELMER EKBLAW

HETTNER, ADOLPH. *Vergleichende Länderkunde.* 4 volumes—Vol. I, viii and 221 pp.; Vol. II, viii and 172 pp.; Vol. III, viii and 202 pp.; and Vol. IV, x and 347 pp. All richly illustrated with maps, charts, and photographs. B. G. Teubner Press, Leipzig and Berlin, 1933–35.

The four volumes, which comprise the remarkably complete and satisfactory series on comparative geography by Adolph Hettner, present a wealth of geographic material in the highest quality and the most compacted form. So excellent is the series that no geographer can afford to be without it, no library to fail to set it upon its shelf of most valuable geographic references. No praise can be too enthusiastic, or exaggerated. The four volumes constitute a truly noteworthy contribution to the literature of modern geography.

Comment beyond cordial approval and unqualified praise is unnecessary. Summary of the contents of the several volumes will give the best information regarding the scope and character of the work. Errors there may be, but the entire effect is one of approach to perfection, and none but a captious critic could find fault.

Volume I is divided into two parts—the earth itself and its geologic attributes and history with an inclusive appendix on mathematical geography constitute Part I. Part II is subdivided into three divisions, the first being concerned with distribution of the continents, the islands, and the seas; the second, with the structure and forms of the land masses, their composition and characteristics; and the third which comprises Volume II, a continuation of the physical phases presented in Volume I.

Volume II, accordingly, deals with geomorphology and physiography. The processes of erosion and the land forms resulting from them; the types of landscape resulting from tectonic processes; the types of landscape in various climates; the phenomena of glaciation; the character, kinds, and distribution of deserts; and the attributes of coasts; all these compose the subject matter of this second volume, and afford a most extensive, yet definite, view of the whole field, through modern glasses.

Volume III, which not only maintains but increases the interest which the first two volumes have developed, is again divided into two parts,

of which the first constitutes part three of the whole series. Part three treats the distribution and arrangement of the waters of the land masses—snow, icefield, and glacier; groundwater and springs; streams; seas; the quantity and composition of ground and surface waters. Part four, dealing with climate, is subdivided into two divisions, of which the first presents the elements of climate; insolation; atmospheric circulation; composition of the air; vapor, clouds, and precipitation; light and sky; and climate as a whole. The second division presents the climates of the tropics, the subtropics, and the extratropics, and the composition of the climate of the several continents, in a most up-to-date and stimulating way.

Volume IV, the final volume, contains the last four parts of the series. Part five deals wholly with the geography of plants; their importance; their migration and distribution; the factors of their habitats; the characters of floras, and their historical evolution; their life-forms and their growth-forms; the plant regions; and a summary of the plant cover of the earth. Part six treats the animal life as systematically and fully as part five discusses plant life. Part seven forms a condensed summary of human geography. The ten chapters of part seven deal with the quality and origin of man; his evolution and distribution; the races into which men are divided; man's culture; his settlement and occupancy of the earth; his commerce and communications; his industries and economy; his material and spiritual culture; the attributes of his tribes or clans, his speech, his religion; and his state of government. Part eight is an outline of regional types and the regional approach to the study of geography. The chapters deal with the bases for regions; physiographic regions; climatic regions; floral and faunal regions; anthropogeographic regions; and the land forms, lands, and landscapes of the earth.

By thus inventorying the material of the series and approving its method and content, the review should convey some adequacy of opinion regarding the merits of the work to those whose major field of interest and activity is geography or any of its related sciences. Though naturally printed in the German language, the series is invaluable as reference; if it were translated into English it would certainly find a broad field of usefulness and sale among the colleges and universities of America.

W. ELMER EKBLAW

TREWARTHA, GLENN THOMAS. *A Reconnaissance Geography of Japan.* 283 pp. University of Wisconsin Studies in the Social Sciences and History, No. 22. University of Wisconsin, Madison, 1934. Price, $2.00.

Doctor Trewartha has made an extremely valuable study of Japan. He has given us our first modern regional description in English of the Japanese islands. The reviewer is greatly impressed by the thoroughness with which the author has accomplished his task. The general introduction treating the natural features and the culture or occupance features in about 75 pages, can be strongly recommended even for those who are not interested in regional description.

Five regional subdivisions form the basis of regional discussion: Hokkaido, Ou, Chubie, the Inner Zone of Southwest Japan, and the Pacific Folded Mountains or Outer Zone of Southwest Japan. Each subdivision is then again divided into smaller units.

The use of many Japanese topographic maps to illustrate regional features has been very successful, while a legend in English makes interpretation possible. If in addition general regional maps were provided, showing landscape features like those made by Erwin J. Raiss for Preston E. James's "An Outline of Geography" they would have been very helpful in visualizing the landscape.

It might be suggested also that the picture plates at the end of the book should have been on better paper; quite a number do not now show the details they are selected for. An index would likewise have been helpful at the end of the book. These are only minor complaints which should not detract from the value of the study.

The author's style is clear and, in spite of the enormous amount of information given, makes easy reading. In some cases a little more vivid description would have been an asset, but after all geography is not generally regarded as one of the "fine arts."

SAMUEL VAN VALKENBURG

EMENY, BROOKS. *The Strategy of Raw Materials.* xiv and 202 pp.; maps, charts, and graphs; bibliography; and index. The Macmillan Company, New York, 1934. Price, $3.00.

In *The Strategy of Raw Materials* Brooks Emeny summarizes the economic and geographic elements in the effectiveness of sanctions as invoked by the League of Nations against an aggressor nation. In the light of the present League-Italo-Ethiopian crisis, the essential facts presented in this authoritative and illuminating volume, take on new significance. As an explanation of the basic considerations which lie beneath the policy of sanctions, the book is an extremely valuable and timely work. Anyone in doubt as to the adequacy of economic sanctions as a means toward peace, can hardly help being convinced by the startling but substantial facts presented; in themselves they constitute for peace an argument of the first potency.

The first chapter of the book is devoted to comparison of the relative self-sufficiency of the seven great powers in the essential raw materials of war; the second deals with the general situation of the United States in vital foodstuffs, and

industrial raw materials including minerals, textiles, and others; the third discusses the method of analysis whereby the deficiency or sufficiency of strategic raw materials is determined; the fourth treats of the role of steel alloy metals; the fifth with miscellaneous materials; the sixth, with rubber, fibers, and hides; the seventh, with medicines and drugs, shellac, coconut shells, coffee, and sugar. Two interesting appendices presenting the strategic situations of the United States, and of the Great Powers complete the volume.

The necessity for providing sufficiency of strategic raw materials for defense against aggression concerns every government, and helps shape the foreign policy of most of the states. The international control, allocation, and regulation of the supplies of raw materials would seem to be an extension of cooperation among states that would not only tend to universal and permanent peace, but would immeasurably advance civilization.

The Strategy of Raw Materials is one of those indispensable source books which every man must read and understand to be able to appraise the course of diplomacy and international relations, to appreciate contemporary history. Rich in the statistical material upon which history, geography, and economics must depend to interpret the human phenomena of their respective fields, the book deserves a place in every public and private library. It is a contribution to good citizenship as well as to technical knowledge.

W. ELMER EKBLAW

ECONOMIC GEOGRAPHY

A QUARTERLY journal of Economic Geography published by Clark University for the benefit of geographers, economists, teachers, professional and business men, and all who are interested in the intelligent utilization of the world's resources.

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The October issue of Volume 11 contains the following articles:

Agricultural Regions of Asia: Part VIII—Malaysia (continued), Samuel van Valkenburg, Clark University, Worcester, Massachusetts.
How Big Is Japan? A. E. Parkins, George Peabody College for Teachers, Nashville, Tennessee.
A New Map of the Dairy Areas of the United States, Richard Hartshorne, University of Minnesota, Minneapolis, Minnesota.
Land Use in the Upper Ardeche River Valley of France, Earl B. Shaw, State Teachers College, Worcester, Massachusetts.
The Knit-Goods Industry in the Southern States, Ben F. Lemert, Duke University, Durham, North Carolina.
Minnesota Forest Situation, George H. Primmer, State Teachers College, Duluth, Minnesota.
Small Farming on Kauai: Hawaiian Islands, John Wesley Coulter, University of Hawaii, Honolulu, Hawaii.
The Localization of Functions in the Pomona Area, California, Willis H. Miller, Los Angeles Junior College, California.
The Iron Ore Resources of China, W. Belden, Clark University, Worcester, Massachusetts, and M. Salter, Scripps College, Claremont, California.

July includes:

Social and Economic Factors in Land-Use Planning in the Northeastern States, Jacob G. Lipman, College of Agriculture, New Brunswick, New Jersey.
Agricultural Regions of Asia: Part VIII—Malaysia, Samuel van Valkenburg, Clark University, Worcester, Massachusetts.
The Pacific Coast Halibut Fishery, John Q. Adams, University of Missouri, Columbia, Missouri.
Industrial Development in São Paulo State, Brazil, Preston E. James, University of Michigan, Ann Arbor, Michigan.
Population Adjustments in Our Virgin Islands, Earl B. Shaw, State Teachers College, Worcester, Massachusetts.
Cities of the Puget Basin, George T. Renner, National Resources Board, Washington, D. C.
Huepac: An Agricultural Village of Sonora, Mexico, Leslie Hewes, University of Oklahoma, Norman, Oklahoma.
Distribution of Deerfield River Power, A. K. Botts, New York State Normal and Training School, Cortland, New York.
The Coal Resources of China, W. Belden and M. Salter, Scripps College, Claremont, California.
Economic Geography of Bulgaria, Joseph S. Roucek, New York University, New York, N. Y.

April includes:

Salmon Industry of the Pacific Coast, Otis W. Freeman, State Normal School, Cheney, Washington.
Agricultural Regions of Asia: Part VII—The Japanese Empire, Robert Burnett Hall, University of Michigan, Ann Arbor, Michigan.
Water Power Development on the Deerfield River, A. K. Botts, Cortland State Normal and Training School, Cortland, New York.
A Distressed Industrial Region—Tyneside, George H. J. Daysh, Armstrong College, University of Durham, Newcastle-upon-Tyne, England.
Cultural Adjustments to the Mesabi Resources, Paul H. Landis, National Resources Board, Brookings, South Dakota.
Central Florida Farm Landscape, Samuel N. Dicken, University of Minnesota, Minneapolis, Minnesota.
The Chewing Gum Industry, Charles Landon, Duke University, Durham, North Carolina.
Geography of the Glaciated North Idaho Panhandle, J. Wright Baylor, U. S. Soil Erosion Service, Pullman, Washington.
Agricultural Land Utilization in Denmark, Daniel R. Bergsmark, University of Cincinnati, Cincinnati, Ohio.

January includes:

Geographical Controls of Agriculture in Orkney and Shetland, Andrew C. O'Dell, Birkbeck College, University of London, England.
Seattle as a Port City, Albert L. Seeman, University of Washington, Seattle, Washington.
Agricultural Regions of Asia: Part VII—The Japanese Empire, Robert Burnett Hall, University of Michigan, Ann Arbor, Michigan.
Human Occupance of the St. Clair Delta, Bert Hudgins, Wayne University, Detroit, Michigan.
Dominica: A Wet Tropical Human Habitat, Lucia Carolyn Harrison, Western State Normal College, Kalamazoo, Michigan.
Rural Settlement in North West Devon, England, Beatrice M. Swainson, Lincoln Training College, Lincoln, England.
Economic Geography of Greece, Joseph Slabey Roucek, Pennsylvania State College, State College, Pennsylvania.
The Rayon Industry in Japan, Shinichi Suzuki, University of Hawaii, Honolulu, Hawaii.

The October issue of Volume 10 contains the following articles:

Agricultural Regions of Asia: Part VII—The Japanese Empire, Robert Burnett Hall, University of Michigan, Ann Arbor, Michigan.
Agricultural Occupation of Hokkaido, D. H. Davis, University of Minnesota, Minneapolis, Minnesota.
Spring and Winter Wheat on the Columbia Plateau, Victor Roterus, State College of Washington, Pullman, Washington.
Geographic Aspects of Coal Cargoes from Toledo, Walter G. Lezius, University of Toledo, Toledo, Ohio.
The Sweet Corn Industry of Maine, Albert S. Carlson and John Weston, Dartmouth College, Hanover, New Hampshire.
Future of Lake Superior Iron Ore Supply, George H. Primmer, State Teachers College, Duluth, Minnesota.
The Los Angeles Harbor Fishing Center, Clifford M. Zierer, University of California, Los Angeles, California.
The Development and Decline of Skagway, Alaska, Edwin J. Foscue, Southern Methodist University, Dallas, Texas.

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ANNOUNCEMENT

IN THE following issues of ECONOMIC GEOGRAPHY Dr. Samuel van Valkenburg will continue the *Agricultural Regions of Asia*. In later issues Dr. Homer L. Shantz, President of the University of Arizona, will contribute his series on *Agricultural Regions of Africa* which, upon conclusion, will complete the finest geographic discussion of the world's agriculture thus far established.

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